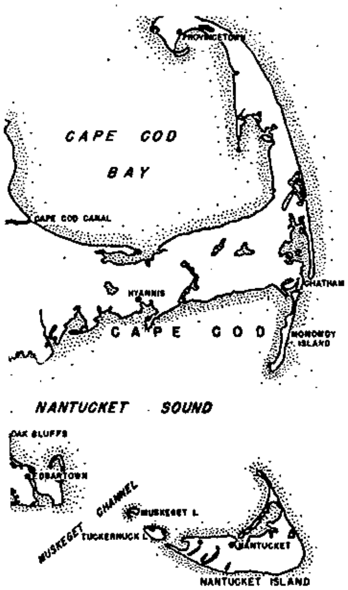
US Army Corps of Engineers



PROCEEDINGS
OF THE 40TH MEETING OF THE
COASTAL ENGINEERING RESEARCH BOARD

18-20 October 1983
North Falmouth, Massachusetts

Hosted by
U. S. Army Engineer Division,
New England

January 1984
Final Report

Approved For Public Release; Distribution Unlimited

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PREFACE

These proceedings of the 40th meeting of the Coastal Engineering Research Board (CERB) were prepared for the Office, Chief of Engineers, by the Coastal Engineering Research Center (CERC), U. S. Army Engineer Waterways Experiment Station (WES). They provide a brief record of the meeting, the questions it raised, and CERC's response to those questions.

The meeting was hosted by the U. S. Army Engineer Division, New England (NED), under the direction of COL Carl B. Sciple, CE. NED is to be commended for its organization of presentations, its provision for attendees, and its help in preparing these proceedings (most of the abstracts included herein were prepared by NED). Special thanks are due Mr. Thomas C. Bruha, NED, and Mrs. Harriet Hendrix and Ms. Taffy Stept, WES, for assembling and organizing the information here presented.

Members of the CERB, BG C. E. Edgar III, CE, BG James Van Loben Sels, CE, BG Thomas A. Sands, CE, Mr. Willard Bascom, Prof. Bernard LeMéhauté, and Prof. Robert L. Wiegel, participated actively in all discussions and provided many thoughtful and instructive comments.

The proceedings were reviewed and edited by Dr. Robert W. Whalin, Chief, CERC. Mr. F. R. Brown, Technical Director, WES, and COL Tilford C. Creel, CE, Executive Secretary of the Board and Commander and Director, WES, provided additional review.

Approved for publication in accordance with Public Law 166, 79th Congress, approved 31 July 1945, as supplemented by Public Law 172, 88th Congress, approved 7 November 1963.

C. E. EDGAR III
Brigadier General, Corps of Engineers
President, Coastal Engineering Research Board

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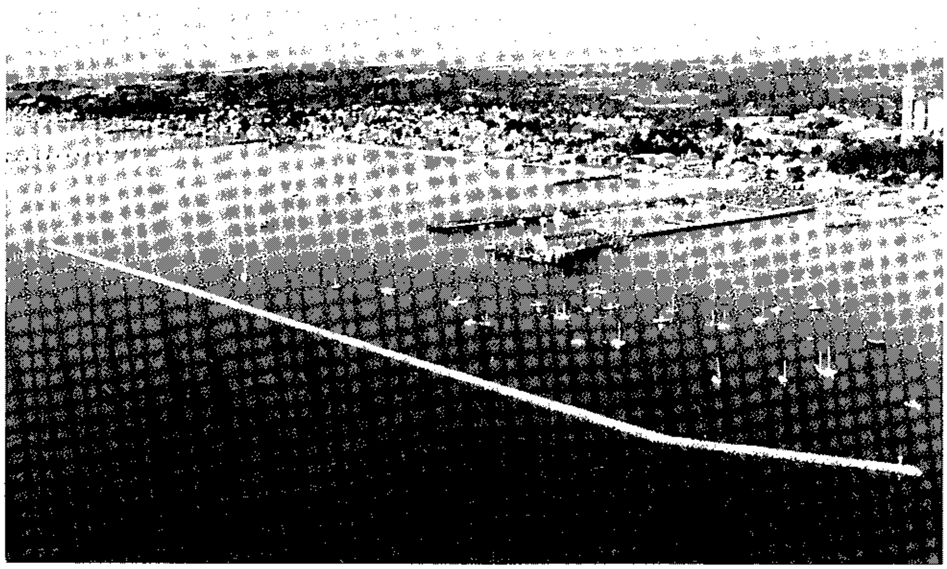
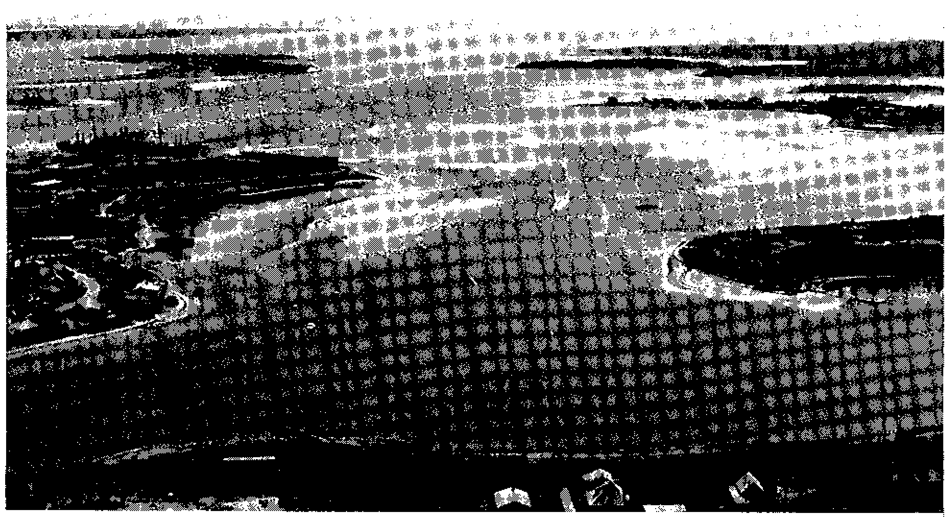


Provincetown Harbor, Massachusetts



Buttermilk Bay, Cape Cod Canal, Massachusetts

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION. CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM. MASSACHUSETTS 02254

REPLY TO ATTENTION OF

October 17, 1983

Executive Office

Welcome to the home of the New England Division, U.S. Army Corps of Engineers. It was here, in the North End of Boston, that the Corps of Engineers began. Colonel Richard Gridley, the first Chief Engineer, was assigned the task of building fortifications for the Battle of Bunker Hill on June 16, 1775.

The Corps has developed a proud heritage of service to the region in the 208 years since our founding. With a total coastline exceeding 6,000 miles, New Englanders have closely tied their economy and recreational pursuits to the water and the shore. Our work has reflected that relationship. We have completed over 100 flood control projects, 175 navigation projects and 34 beach (erosion/renourishment) projects. This Division also pioneered extensive use of "hurricane barriers" and the application of satellite communication to monitor river conditions. The nearby Cape Cod Canal, the world's widest sea-level canal, is owned and operated by the New England Division.

We are honored that the Coastal Engineering Research Board has selected this area for their fortieth meeting. It not only provides an opportunity to discuss our work with leaders in the coastal engineering field, but is also another very positive Corps-related activity in New England we can point to with pride.

I extend every hospitality of the New England Division to you and hope that your meeting is as enjoyable as it is productive.

Sincerely,

Carl B. Sciple
Colonel, Corps of Engineers
Division Engineer

PROCEEDINGS OF THE 40TH MEETING OF THE COASTAL ENGINEERING RESEARCH BOARD

18-20 October 1983

North Falmouth, Massachusetts

PART I: INTRODUCTION

On 18-20 October 1983, the Coastal Engineering Research Board (CERB) of the U. S. Army Corps of Engineers met at Old Silver Beach in North Falmouth, Massachusetts, for their fortieth semiannual meeting. The meeting was hosted by the U. S. Army Engineer Division, New England, under the direction of COL Carl B. Sciple, CE; the Division additionally provided tours of the New Bedford, Massachusetts, Hurricane Barrier; the Cliff Walk at Newport, Rhode Island; Cape Cod Canal; and the Woods Hole Oceanographic Institution at Woods Hole, Massachusetts.

The Beach Erosion Board (BEB), forerunner of the CERB, was formed by the Corps in 1930 to study beach erosion problems. In 1963, Public Law 88-172 dissolved the BEB by establishing the CERB as advisory board to the Corps and designating a new organization, the Coastal Engineering Research Center (CERC), as the research arm of the CERB. The CERB functions to review programs relating to coastal engineering research and development to recommend areas for particular emphasis or suggest new topics for study. The Board's four military and three civilian members, listed below, meet twice a year at a particular coastal Corps District or Division to do the following:

a. Disseminate information of general interest to Corps coastal Districts and Divisions.

b. Obtain reports on coastal engineering projects in the host (local) District or Division; receive requests for research needs.

c. Provide an opportunity for State and private institutions and organizations to report on local coastal research needs, coastal studies, and new coastal engineering techniques.

d. Provide a general forum for public inquiry.

e. Provide recommendations for coastal engineering research and development.

Participants at this fortieth meeting (listed by organization below) represented OCE, six Corps Division Offices, one Corps District, two Corps Laboratories, three Federal Agencies, four State Agencies, four universities, and one private firm. The agenda below gives a chronological list of the topics presented, by speaker, and field trip visits.

These proceedings provide both a record of the meeting and a response to questions raised. The parts that follow present brief abstracts of presentations, descriptions of projects toured, comments of the Board members, and CERC's response to those comments and to participants' research needs. Full texts of four presentations of particular significance are included as Appendix A. A map of the North Atlantic Region, location of the projects and study or problem areas described herein, appears at the end of this part.

PARTICIPANTS

Coastal Engineering Research Board (CERB)

BG C. E. Edgar III
BG James van Loben Sels
BG Thomas A. Sands
BG Robert J. Dacey (absent)
Mr. Willard Bascom
Prof. Bernard LeMéhauté
Prof. Robert L. Wiegel

Office, Chief of Engineers (OCE)

Dr. James Choromokos
Mr. Vernon Hagen
Mr. John Housley
Mr. John Lockhart
Dr. William E. Roper
Mr. Robert D. Teeters

Coastal Engineering Research Center (CERC), Waterways Experiment Station (WES)

COL Tilford C. Creel
Mr. H. Lee Butler
Mrs. Harriet Hendrix
Dr. James R. Houston
Dr. Lewis E. Link
Dr. Dennis R. Smith
Dr. Robert W. Whalin

U. S. Army Cold Regions Research and Engineering Laboratory (CRREL)

Dr. Lloyd Breslau

New England Division (NED)

COL Carl B. Sciple
Mr. Don Birmingham
Mr. Lawrence Blake
Mr. John Borchardt
Mr. Thomas C. Bruha
Mr. Jack Caffrey

NED (Continued)

Mr. Michael Carroll
Mr. Francis N. Ciccone
Mr. William Coleman
Mr. Steven W. Congdon
Mr. Richard DeSimone
Mr. James B. Doucakis
Mrs. Susan Douglas
Dr. Franklin W. Fessenden
Mr. Joe Fryar
Miss Barbara Happeny
Mr. Robert L. Harrington
Mr. Robert C. Hunt
Mr. Joseph L. Ignazio
Mr. Forrest Knowles
Ms. Catherine O. LeBlanc
Mr. Christopher J. Lindsay
Mr. Anthony Mancini
Mr. Donald Martin
Mrs. Susan Mehegan
Mr. Michael D. Misslin
Mr. Frank A. Morris
Mr. Warren Nordman
Mr. James O'Connell
Mr. Felipe Ortiz
Mr. Larry Parente
Mr. Richard F. Quinn
Mrs. Catherine E. Ravens
Mr. Fred Ravens
Mr. John Reis
Mr. Anthony R. Riccio
Miss Mary Ronan
Mr. Tom J. Rosato
LTC Lee T. Schwegler
Mr. Wallace St. John
Mr. Charles J. Wener
Miss Ann Wright

New York District (NAD)

Mr. Gilbert Nersesian

North Pacific Division (NPD)

Mr. John G. Oliver

South Atlantic Division (SAD)

Mr. Frank Posey
Mr. James F. Robinson

South Pacific Division (SPD)

Mr. Walter C. Day

Southwestern Division (SWD)

Mr. Ronald DeBruin
Mr. Mike Kieslich

National Oceanic and Atmospheric Administration (NOAA)

Dr. James Winchester

Water Resources Support Center (WRSC)

Mr. David Mathis

Woods Hole Oceanographic Institution (WHOI)

Dr. David G. Aubrey

Maine State Planning Office

Mr. David Keeley

New Hampshire Civil Defense

Mr. James Minnock

Massachusetts Environmental Management

Dr. Redmond K. Clark

Massachusetts Coastal Zone Management

Mr. Jeff Benoit

University of Connecticut

Dr. W. Frank Bohlen

Boston University

Dr. Duncan Fitzgerald

University of Maine

Dr. Kenneth Fink
Dr. B. R. Pearce

University of Rhode Island

Dr. Peter Cornillon

Anderson-Nichols

Mr. William Richardson

Public

Athanasios A. Vulgaruspulos

AGENDA

17 OCTOBER 1983	Check in	
18 OCTOBER 1983		
0815 - 0820	Opening Remarks	BG Edgar
0820 - 0825	Welcome to New England Division	COL Sciple
0825 - 0845	Profile of the Relocated CERC and Discussion of CERB Business	COL Creel
0845 - 0905	FY 84 Coastal Engineering Research and Development Program/Coast of California Study	Dr. Whalin
0905 - 0925	Streamlining of NOAA Contract Procedures	Dr. Winchester
0925 - 0945	Remote Sensing Opportunities in Coastal Engineering	Dr. Link
0945 - 1000	Break	
1000 - 1020	CRREL Arctic Ocean Engineering Program	Dr. Breslau
1020 - 1040	New England Division Overview	COL Sciple
1040 - 1100	New England Shoreline Overview	Mr. Bruha
1100 - 1120	NED/CERC Wind Information Computer Programs	Mr. Wener
1120 - 1140	Some Applications of Wind Data Analyses: NED	Dr. Fessenden
1140 - 1200	Willard Beach Erosion Control	Ms. LeBlanc
1200 - 1330	Lunch	
1330 - 1350	Saco River Icebreaking Structures	Mr. Misslin
1350 - 1410	Oakland Beach Monitoring Program	Mr. Coleman
1410 - 1430	Cliff Walk Shore Restoration and Protection Project	Mr. Harrington
1430 - 1450	New Bedford Harbor Hurricane Barriers	Mr. Ignazio
1450 - 1510	Revere Tidal Flood Control	Mr. Hunt

18 OCTOBER 1983 (Cont'd)

1510 - 1525	Break	
1525 - 1540	Bay of Fundy Tidal Power Study: Overview	Mr. Ignazio
1540 - 1550	Bay of Fundy Tidal Power Study: Proposed CERC Role	Dr. Houston
1550 - 1610	Problems Associated with Current Coastal Engineering Criteria	Mr. Riccio
1610 - 1640	Dredged Material Management in New England and Automated Monitoring of Dredge Disposal Operations	Mr. Lindsay and Mr. Congdon
1640 - 1700	Long Island Sound Dredged Material Containment Study	Mr. Quinn
1700 - 1710	Administrative Details	
1710	Closing Comments	
1800	Dinner	
2000 - 2045	Poster Session (optional):	
	Nearshore Research at Woods Hole Oceanographic Institution	Dr. Aubrey
	The Blizzard of 1978	Mr. Caffrey

19 OCTOBER 1983

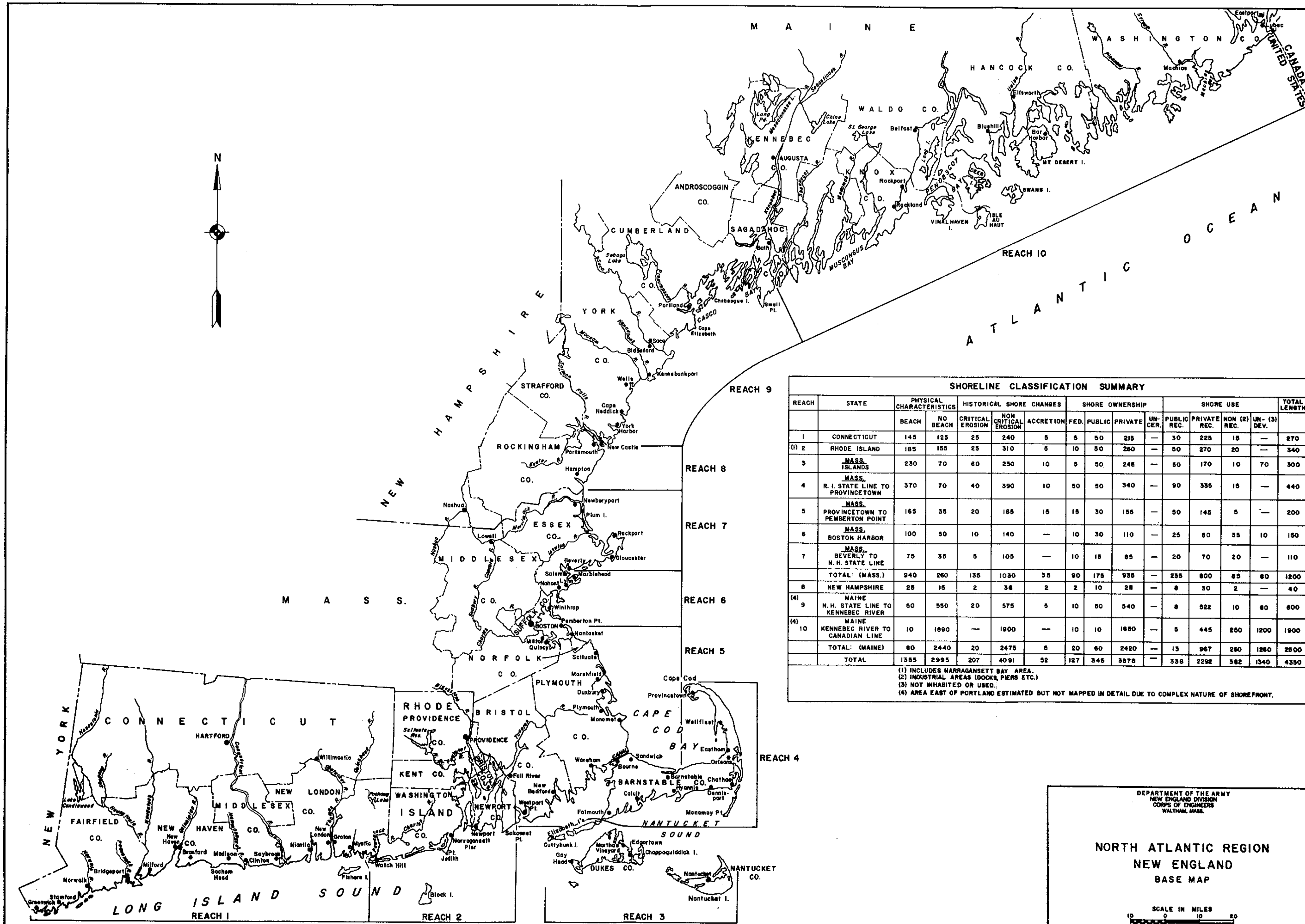
0800 - 0815	Field Trip Itinerary	Mr. Doucakis
0815 - 1700	Field Inspection	
1730	Dinner: Clam Bake	
2000 - 2045	Poster Session (optional):	
	Cape Cod Canal Tugboat Sinking	Mr. Morris

20 OCTOBER 1983

0830 - 0835	Open Meeting	BG Edgar
0835 - 0840	Announcements	
0840 - 0900	Discussion of Field Inspection	
0900 - 0930	Public Comments	

20 OCTOBER 1983 (Cont'd)

0930 - 0950	NED Research Needs	Mr. Blake
0950 - 1015	Coastal High-Hazard Zone and Damage Mitigation Measures: Local Perspective of Engineering Research Needs	Dr. Clark and Mr. Richardson
1015 - 1030	Break	
1030 - 1050	Connecticut Coastal Studies: Wind-Wave Characteristics in Long Island Sound	Dr. Bohlen
1050 - 1110	Massachusetts Coastal Area	Dr. Fitzgerald
1110 - 1130	Maine Coastal Area	Dr. Fink
1130 - 1150	Waves in the Gulf of Maine	Dr. Pearce
1150 - 1210	Interfacing Remotely Sensed Observations and Coastal Process Models	Dr. Cornillon
1210 - 1225	CERB Recommendations	
1225 - 1245	Selection Date and Place of Next Meeting	
1245 - 1255	Closing Remarks	
1255	Adjournment	



REACH	STATE	PHYSICAL CHARACTERISTICS		HISTORICAL SHORE CHANGES			SHORE OWNERSHIP				SHORE USE				TOTAL LENGTH
		BEACH	NO BEACH	CRITICAL EROSION	NON CRITICAL EROSION	ACCRETION	FED.	PUBLIC	PRIVATE	UN-CER.	PUBLIC REC.	PRIVATE REC.	NON (2) REC.	UN- (3) DEV.	
1	CONNECTICUT	145	125	25	240	5	5	50	215	—	30	225	15	—	270
(1) 2	RHODE ISLAND	165	155	25	310	5	10	50	280	—	50	270	20	—	340
3	MASS. ISLANDS	230	70	60	230	10	5	50	245	—	50	170	10	70	300
4	MASS. R. I. STATE LINE TO PROVINCETOWN	370	70	40	390	10	50	50	340	—	90	335	15	—	440
5	MASS. PROVINCETOWN TO PEMBERTON POINT	165	35	20	165	15	15	30	155	—	50	145	5	—	200
6	MASS. BOSTON HARBOR	100	50	10	140	—	10	30	110	—	25	80	35	10	150
7	MASS. BEVERLY TO N. H. STATE LINE	75	35	5	105	—	10	15	85	—	20	70	20	—	110
	TOTAL: (MASS.)	940	260	135	1030	35	90	175	935	—	235	800	85	80	1200
8	NEW HAMPSHIRE	25	15	2	36	2	2	10	28	—	8	30	2	—	40
(4) 9	MAINE N. H. STATE LINE TO KENNEBEC RIVER	50	550	20	575	5	10	50	540	—	8	522	10	60	600
(4) 10	MAINE KENNEBEC RIVER TO CANADIAN LINE	10	1890	—	1900	—	10	10	1880	—	5	445	250	1200	1900
	TOTAL: (MAINE)	60	2440	20	2475	5	20	60	2420	—	13	967	260	1260	2500
	TOTAL	1365	2995	207	4091	52	127	345	3878	—	336	2292	382	1340	4350

SHORELINE CLASSIFICATION SUMMARY

(1) INCLUDES NARRAGANSETT BAY AREA.
(2) INDUSTRIAL AREAS (DOCKS, PIERS ETC.)
(3) NOT INHABITED OR USED.
(4) AREA EAST OF PORTLAND ESTIMATED BUT NOT MAPPED IN DETAIL DUE TO COMPLEX NATURE OF SHOREFRONT.

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

NORTH ATLANTIC REGION
NEW ENGLAND
BASE MAP

PART II: ABSTRACTS OF PRESENTATIONS OF 18 OCTOBER 1983

Profile of the Relocated CERC and Discussion of Old CERB Business

By: COL Tilford C. Creel, WES

Relocation of CERC

The Coastal Engineering Research Center (CERC) relocated on 1 July 1983 from Fort Belvoir, Virginia, to the U. S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Mississippi, moving approximately 50 percent of its professional staff plus wave tanks, wave-generating equipment, computer equipment, and the CERC technical library. The rapid hiring of practically a full complement of personnel and the additional support of WES's other four Laboratories and support facilities have increased CERC's ability to function as both a research and project-oriented Corps Laboratory. Current joint Laboratory projects are the study of storm-induced water levels and currents in the Atchafalaya Bay, Louisiana, with the Hydraulics Laboratory; studies of dolos armor units with the Structures Laboratory; and the Repair, Evaluation, Maintenance, and Rehabilitation (REMR) program, which includes all five Laboratories at WES.

Old CERB Business

As requested at the previous (39th) CERB meeting, the following has been or will be done:

a. A presentation on CERC remote sensing will be given here by Dr. Ed Link, Assistant Chief, CERC.

b. A U. S. Army Cold Regions Research and Engineering Laboratory (CRREL) presentation on arctic ocean engineering will be given here by Dr. Lloyd Breslau, Technical Director, CRREL.

c. Investigation of data gathered at Presque Isle, Pennsylvania, will be addressed in a comprehensive report at the next CERB meeting.

d. More comprehensive review of CERC's research program is being accomplished. An advisory consultants' meeting was held with success on 22-23 August 1983 at WES attended by Mr. Bascom and Professors Wiegel, LeMéhauté, Dean, and Reid. Such a meeting will be held annually.

e. We are pursuing the establishment of standby funds and panel of advisors to immediately investigate coastal storm effects.

f. A CERC-National Oceanic and Atmospheric Administration (NOAA) meeting to discuss publishing CERC and NOAA data in a combined, easily usable form is forthcoming. CERC is now sending all its wave data reports to the National Technical Information Service. Wave Information Study hindcast data and wind field information are being forwarded to the National Climatic Data Center in Ashville, North Carolina, for dissemination to the public.

COL Tilford C. Creel is Commander and Director of the U. S. Army Engineer Waterways Experiment Station in Vicksburg, Mississippi. He is directly responsible for a $100 million research, testing, and development program at the principal laboratory complex of the U. S. Army Corps of Engineers.

COL Creel received a Bachelor of Science degree in Civil Engineering from Johns Hopkins University and a Masters Degree in Education from Northeastern University, Boston, Massachusetts. A graduate of the Command and General Staff College at Fort Leavenworth, Kansas, he also was graduated from the U. S. Naval War College in Newport, Rhode Island, with highest distinction.

His military awards include the Bronze Star Medal with oak leaf cluster, Meritorious Service Medal with oak leaf cluster, Army Commendation Medal, Air Medal, Meritorious Unit Citation, and Republic of Vietnam decorations. He is a native of Des Moines, Iowa.

FY 84 Coastal Engineering Research and Development Program/Coast of California Study

By: Dr. Robert W. Whalin, CERC, WES

Coast of California Storm and Tide Wave Study

Part of a program to reduce and prevent shoreline erosion in California, this planning study is being conducted by the U. S. Army Engineer District, Los Angeles, with CERC as technical advisor, to do the following: (a) document long-term shoreline changes, (b) determine processes responsible for these changes, (c) quantify coastal sand transport, and (d) apply techniques for quantifying coastal changes according to California coastal region to provide a basis for coastal planning decisions. CERC is assisting the District in developing a plan of study, evaluating contract performance, and developing a regional numerical modeling system.

Coastal Engineering Research and Development Program

The FY 84 research and development program comprises 45 percent of CERC's total budget (approximately $13.5 million). The four coastal engineering functional areas being investigated are as follows:

a. The Coastal Flooding and Storm Protection program includes wave estimation and nearshore wave direction studies, continuing data gathering at the Field Research Facility, and the Hurricane Surge Data Collection program in cooperation with the National Ocean Service and the Shell Oil Company.

b. The Harbor Entrances and Coastal Channels program includes studies of wave-current interactions at entrances and measurement of nearshore current fields and waves to improve predictive techniques.

c. The Shore Protection and Restoration program comprises (a) barrier island sedimentation studies to better understand sedimentary histories of those islands and (b) movable-bed modeling and scaling techniques to provide a system of quantifying the shore processes in a large regional area at different temporal and spatial scales (see Coast of California study, above).

d. The Coastal Structure Evaluation and Design program comprises technology transfer (the Shore Protection Manual should be published by early summer 1984 with substantial revisions to sections on wave climatology and spectra) and evaluation of navigation and shore protection structures (the floating breakwater study in Puget Sound done in cooperation with the University of Washington and the U. S. Army Engineer District, Seattle, has produced useful data).

CERC's participation in the REMR program involves studies in rehabilitation of rubble-mound structure toes and development of methods to minimize maintenance in coastal navigation channels.

Dr. Robert W. Whalin is Chief of the Coastal Engineering Research Center at the U. S. Army Engineer Waterways Experiment Station; he held the position of Technical Director of CERC until that Laboratory's move to WES on 1 July 1983. Dr. Whalin received his B.S. degree from the University of Kentucky, his M.S. from the University of Illinois, and his Ph. D. from Texas A&M University. Listed in American Men and Women of Science, he is a member of the International Association for Hydraulic Research, the Permanent International Association of Navigation Congresses, the American Society of Civil Engineers, the Society of American Military Engineers, and the Tsunami Society.

Streamlining of NOAA Contracting Procedures*

By: James W. Winchester, Associate Administrator, National Oceanic and Atmospheric Administration

Inefficient, poorly managed contract procedures waste money and create conflict between business and Government and Federal employee resistance to contracting. Poor Federal contract procedures are characterized by long delays, cost overruns, poor products, and defaults, much of which is due to the distance between procurement and technical staffs. The solution to contracting problems is to (a) elevate the procurement staff to the proper organization level and (b) make sure procurement receives adequate support and cooperation from technical personnel. The concept of outside contracting must be an Agency policy supported by senior management.

The information contained in Office of Management and Budget (OMB) Circular No. A-76 (Revised 1983), in strong support of obtaining products and services from commercial sources by awarding contracting responsibility to a high level of Agency management, has aided NOAA in streamlining its contract procedures. Presently, NOAA is realizing 30-60 percent savings through contracting with industry. For contracts to be useful they must be (a) awarded in a timely manner and (b) responsive to program needs. Success depends upon fulfillment of the following four requirements:

a. Proximity and organization of contracting office should be such that the office is (1) as close as possible to technical personnel and (2) set up to handle efficiently many types of contracts while maintaining a workload of standard procurements.

b. The type and content of requests for proposal (RFP's) and the subsequent contract should reflect the technical complexity of the product or service required. In research and development (R&D) procurements, for example, technical factors should weigh much more than cost.

c. Evaluation criteria and the source-selection process should reflect close coordination between technical and contracting staff. R&D procurements, as well as provisions of services of undetermined volume, should usually be made according to cost-plus fixed fee or cost-plus incentive contracts, while shelf items should be purchased under fixed price contracts.

d. A good working relationship among members of the contracting team, which includes the program manager, contracting officer, contract officer's technical representative, and legal counsel, should be established to ensure fulfillment of the previous requirements so that the Government will end up buying what it really wants and needs.

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* The full text of Mr. Winchester's speech is included in Appendix A.

James W. Winchester, a physical oceanographer and ocean engineer, is Associate Administrator of the National Oceanic and Atmospheric Administration (NOAA). As such, he assists in the planning and management of all phases of the agency's operations. In addition, he directs the conduct of special studies and projects for enhancing the oceanic and weather services provided to the general public, for evaluating and establishing ocean engineering requirements, and for expanding NOAA's contract research and development programs.

A meteorologist with American Airlines in Chicago and the Navy Hydrographic Office in Washington, D.C., Winchester served as staff oceanographer/meteorologist to several Naval and military commanders during the Korean War. He later served as an oceanographer with the Naval Oceanographic Office, as a research associate in physical oceanography at The Johns Hopkins University, Baltimore, and Head of Field Projects for the Office of Naval Research.

Before his current NOAA appointment, Winchester headed Business and Engineering Consultants, Inc., a Pass Christian, Miss., firm which provides expertise on marine environmental systems evaluation and analysis and other marine-related services. From 1972 to 1977, he directed NOAA's Data Buoy Office in Bay St. Louis, Miss., where he was in charge of developing a variety of automated marine data acquisition systems. From 1966 to 1972, he was Vice President and General Manager of Oceanographic Services, Inc., of Santa Barbara, Calif., a subsidiary of Global Marine, Inc., which specializes in providing marine environmental service to the offshore industry.

Winchester is a member of the American Geophysical Union, the American Meteorological Society, and the Marine Technology Society. He holds master's degrees from American University (public administration) and The Johns Hopkins University (physical oceanography) and a doctorate from Pacific Western University, Encino, Calif., (environmental administration). He also was awarded a certificate in aerological engineering by the U.S. Naval Aerological School, a predecessor to the U.S. Naval Post Graduate School.

Remote Sensing Opportunities in Coastal Engineering

By: Dr. Lewis E. Link, CERC, WES

Introduction

Corps of Engineers' studies, projects, and operation and maintenance efforts all require an enormous data collection effort. Remote sensing can provide some of these data at a much reduced cost, in a quick response mode, and over large areas in a short time. The synoptic coverage provided also provides a unique means to extrapolate point measurements and to examine areal phenomena not adequately defined by point data.

Many of the events that occur in nature, especially in coastal engineering, last for a short time (e.g., offshore bars, river deltas, storm waves, etc.). Remote sensing offers the only viable means to characterize these phenomena before they are significantly modified or no longer present. The volumes of data collected by conventional means may be reduced by availability of more relevant information which results in the same or better quality analysis.

Remote sensing technology must be integrated into Corps operational data collection procedures to allow the Corps field offices to cost-effectively acquire the data required for solution of the many complex problems they face. While remote sensing cannot solve all data collection problems, operational techniques exist that can make significant enhancements in Corps data collection capabilities, allow acquisition of unique information, and significantly reduce the cost of data acquisition and analysis.

Remote sensing in coastal engineering

Remote sensing has shown significant potential for coastal data acquisition. Radar technology has evolved that can provide wavelength and wave direction data from the ground. New ground-based radar systems are emerging that will provide directional wave-height spectra out to about 20 km and surface currents out to 60 km from shore and could potentially supplement or even replace the use of discrete location gages, especially in coastal regions that have complex bathymetries. Synthetic aperture radar (SAR) on aircraft can provide all-weather, day-night information on wave direction, wavelength, and shoreline changes.

Aerial photographs have long been used for coastal change studies. Satellite imaging systems are evolving with resolution capabilities sufficient to perform large area mapping of shoreline changes, land use in the coastal zone, and nearshore current and suspended sediment transport patterns. Historical coverage is available through the Landsat (to 1972) and NIMBUS imagery. The Thematic Mapper on Landsat D (30-m resolution) and the soon-to-be-launched French SPOT satellite (up to 10-m resolution) promise enhanced spatial resolution from space along with repetitive coverage and convenient digital format.

Airborne laser systems and aircraft multispectral scanners have demonstrated unique potentials for bathymetric and shoreline topographic mapping. Such systems can be utilized for profile or areal coverage with relatively high resolution. A study by the Defense Mapping Agency and the Naval Ocean Research and Development Activity (NORDA) concluded that airborne laser hydrography could be performed for one-sixth the cost of conventional sonar surveys, required only one-fifth the manpower, and could provide up to a 100-fold increase in data density.

Remote Sensing Demonstration Program

The Corps of Engineers Remote Sensing Demonstration Program provides an opportunity to demonstrate the utility of existing and emerging remote sensing techniques for operational data acquisition in support of Corps field office major information needs. The remote sensing demonstrations are centered around a planned or ongoing District project that requires significant data acquisition over relatively large areas. Emphasis is on the use of remote sensing techniques that have full operational potential.

The first Corps remote sensing demonstration will be initiated in FY 84 in conjunction with the Coast of California Storm and Tidal Waves Study (CCSTWS) being conducted by the Los Angeles District (SPL). Ground-based, aircraft and satellite sensing systems will be utilized in concert with conventional coastal data acquisition techniques to (a) demonstrate operational data acquisition capability, (b) establish cost effectiveness, (c) supplement planned data acquisition, and (d) provide information that will directly assist SPL in accomplishing the objectives and goals of the CCSTW Study.

Dr. Link is currently the Assistant Chief, Coastal Engineering Research Center, a position he assumed in July 1983. Prior to that, he held a dual position as independent researcher and Group Chief, Environmental Constraints Group, Environmental Laboratory, Waterways Experiment Station, where he was responsible for directing major Corps research programs in military hydrology, fixed-installation camouflage and target acquisition, and applied aircraft and spacecraft remote sensing technology for civil and military engineering problems. He participated actively in NATO research and directed a five-year NATO Joint Field Research Trial on thermal camouflage in which scientific teams from five nations participated. Dr. Link also directed and participated in bilateral research programs with the United Kingdom, West Germany, and Israel.

Dr. Link was the principal author and editor of the Remote Sensing Applications Guide, EP 70-1-1, a three-volume work that serves as a principal reference on applying remote sensing technology to engineering and environmental problems. The Guide is widely used within the Corps of Engineers, U. S. Government Agencies, and both U. S. and foreign academic institutions. Since beginning his career in 1968 as a geophysicist with the Waterways Experiment Station, Dr. Link has authored over 70 technical papers and reports on his research.

CRREL Arctic Ocean Engineering Program*

By: Dr. Lloyd R. Breslau, CRREL

The extreme environmental condition and special characteristics of cold regions areas introduce a unique set of problems that are peculiar to cold regions coastal engineering. Some examples of these problems that must be addressed are ice gouging the seafloor and shoreline, spray icing aspects on structures, sub-sea permafrost's influence on foundations, ice rideup on shorelines, ice forces on coastal structures, ice effects on the functioning of coastal installations, and cold regions coastal processes.

CRREL, as a full-spectrum cold regions research and engineering laboratory, has a long and distinguished record of work in this particular area of coastal engineering research. Dr. Breslau's presentation discussed the problems of cold regions coastal engineering research and CRREL's activities in this area.

Dr. Breslau is Technical Director of the U. S. Army Cold Regions Research and Engineering Laboratory located in Hanover, New Hampshire. Dr. Breslau received his formal education at MIT in the disciplines of electrical engineering, geology and geophysics, and oceanography. His doctoral research was performed at the Woods Hole Oceanographic Institution, and he received a Ph. D. in Oceanography in 1964. In 1977 he received a PMD from the Harvard Business School, and in 1979 he completed the Senior Executive Education Program at the Federal Executive Institute.

Since leaving Woods Hole, he has worked for the Office of Naval Research at La Spezia, Italy; the U. S. Naval Oceanographic Office; the U. S. Coast Guard Office of Research and Development at Coast Guard Headquarters; and as Technical Director of the Coast Guard Research and Development Center in Groton, Connecticut.

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* The full text of Dr. Breslau's speech is included in Appendix A.

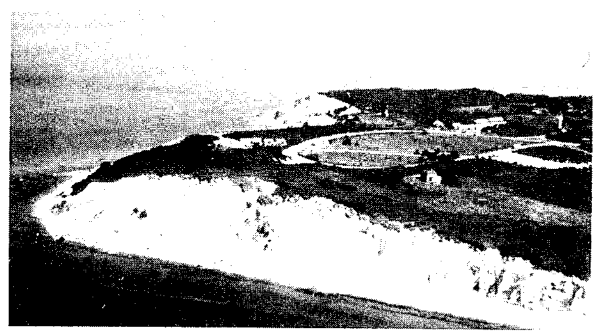
New England Shoreline Overview

By: Thomas C. Bruha, Chief, Shore Protection Section, NED

This overview of the New England shoreline, a video presentation taken from a recent flight of the New England coastline, emphasized the irregular shape and configuration of this unique geological area. The presentation focused on the problems and needs of developing criteria for the design of shore protection improvements in sheltered areas.

Mr. Bruha holds a B.S. in General Engineering from the University of Portland, Oregon. He has been with the Corps of Engineers for more than 20 years, five years of this time with the Seattle District. He is currently Chief of the Shore Protection Section in the Planning Division, NED.

Bedrock beach, Belfast, Maine



Unconsolidated beach, Gay Head, Marthas Vineyard, Massachusetts

Cobble beach, Maine

Variety of the New England shoreline (Continued)

Straight beach, Hampton, New Hampshire

Beach with structures, Parker's River Beach, Yarmouth, Massachusetts

Unconsolidated beach, Oakland Beach, Rhode Island

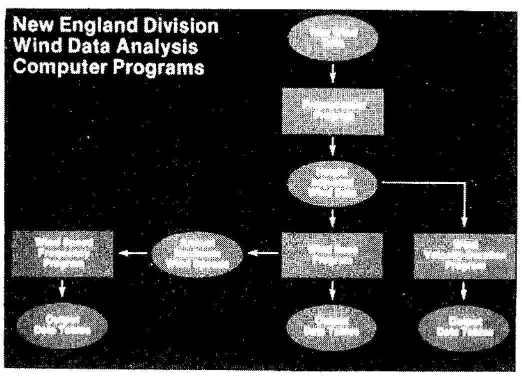
Variety of the New England shoreline (Concluded)

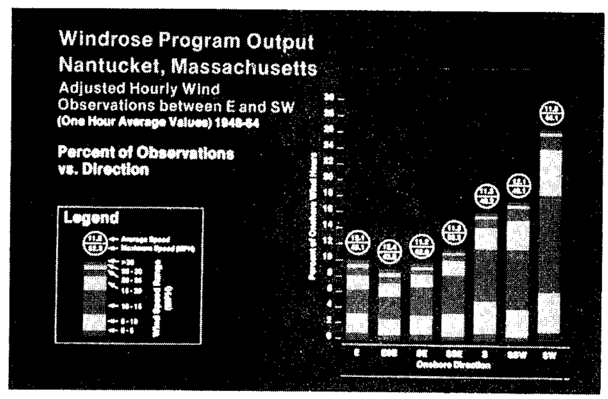
<u>NED/CERC Wind Information Computer Programs</u>

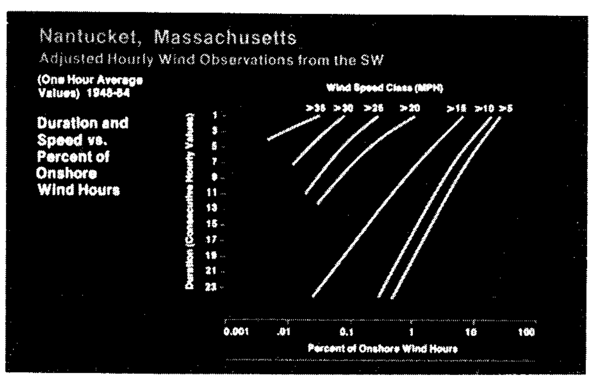
By: Charles J. Wener, Hydraulic Engineer, NED

The New England Division has developed, with assistance from the Office of the Chief of Engineers and the Coastal Engineering Research Center, several computer programs for analyzing systematically recorded wind data. These programs can develop wind rose information as well as wind velocity-duration-frequency relationships. This discussion focused on program application and potential future improvements.

Mr. Wener holds a B.S. in Civil Engineering from the University of Vermont and has completed all course requirements for an M.S. in Water Resources/ Environmental Engineering at Northeastern University. He has been a hydraulic engineer in the Hydraulics and Water Quality Section at the New England Division for nine years.







Some Applications of Wind Data Analyses: NED

By: Dr. Franklin W. Fessenden, NED

There is a variety of shorelines in New England, many of which are sheltered. An understanding of natural coastal processes is necessary in order to solve beach erosion problems; and data, especially wind data, are essential to this understanding.

We refine wind data in the following ways:

a. Determining velocity, occurrence, and duration; e.g., annual frequency of occurrence of winds from a given onshore direction equal to or greater than 25 mph and lasting 2 hours or longer for a particular area.

b. Determining wind effectiveness values; i.e., the percentage of occurrence and potential strength of waves generated by these ±25-mph winds of ±2-hour durations.

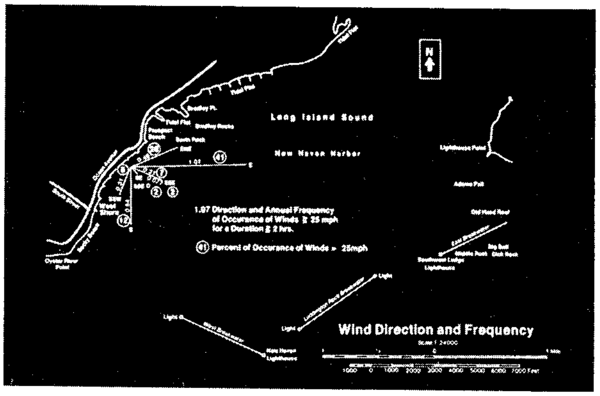
c. Determining beach stability by resolving wind effectiveness value into and on/offshore component and an alongshore component and direction for a particular segment of beach.

d. Determining net longshore transport rate of sand for a given stretch of beach using all of the above.

e. Choosing design wave height for a proposed project using wind velocity and duration.

The danger of overmanipulation of these data can be lessened by means of a monitoring program supported by good primary wave data.

Dr. Franklin W. Fessenden is Professor of Geology at Bently College in Waltham, Massachusetts. Since 1971, he has served concurrently at New England Division as a hydrogeologist, determining the natural coastal processes which occur in problem areas under study to better enable NED to plan solutions. Dr. Fessenden received a B.A. in Geology from Williams College in Williamstown, Massachusetts, an M.A. in Geology from Rice University in Houston, Texas, and a Ph.D. in Hydrogeology from Boston University.

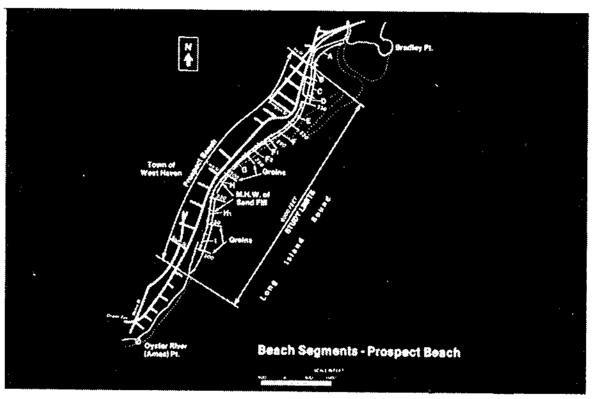


Vector diagram of annual frequency of occurrence of ± 2-hour winds at Prospect Beach, Connecticut

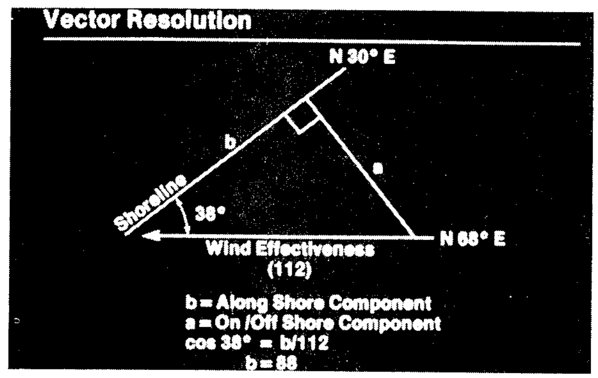
Winds Greater Than 25 MPH

Wind Direction	Wind Effectiveness Value
ENE	112
E	144
ESE	210
SE	50
SSE	40
S	228
SSW	152

Wind effectiveness values: percentage occurrence × fetch



Division of Prospect Beach into segments

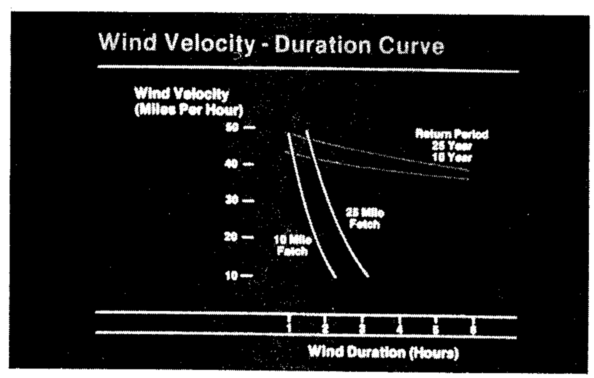


Vector resolution of wind effectiveness value

Q Value Totals for Beach Segments

Beach Segment and Azimuth		Q North	Q South	Q Gross	Q Net
A	55	7501	-6100	13601	1401
B	30	5483	-3869	9352	1614
C	30	5483	-3869	9352	1614
D	21	5117	-2676	7793	2511
E	40	6729	-4904	11633	1825
F	52	7459	-5892	13351	1567
F-1	60	7799	-6174	13973	1625
F-2	42	6830	-5034	11864	1796
G	40	6729	-4904	11633	1825
H	33	5634	-4242	9876	1392
H-1	19	5242	-2580	7811	2662
I	20	5230	-2630	7860	2600

Longshore transport rates (Q) for each section of Prospect Beach



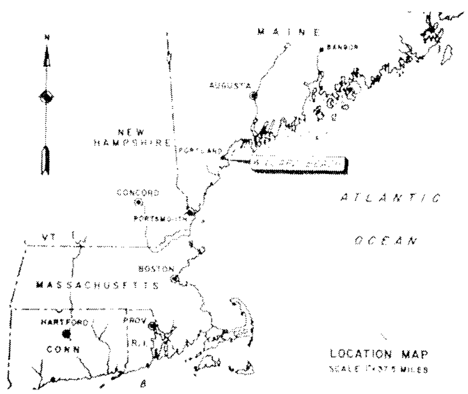
Wind velocity-duration curves used to determine design wave heights

Willard Beach Erosion Control

By: Catherine O. LeBlanc, Project Manager, NED

The 2,000-foot-long Willard Beach is located in South Portland, Maine. One of the few public beaches in the greater Portland area, the beach has been subjected to serious erosion over the years. The New England Division recently completed a study of the area which recommended improvements to include beach widening and construction of a terminal groin structure. Ms. LeBlanc discussed problems which arose during project design and the various alternative solutions investigated.

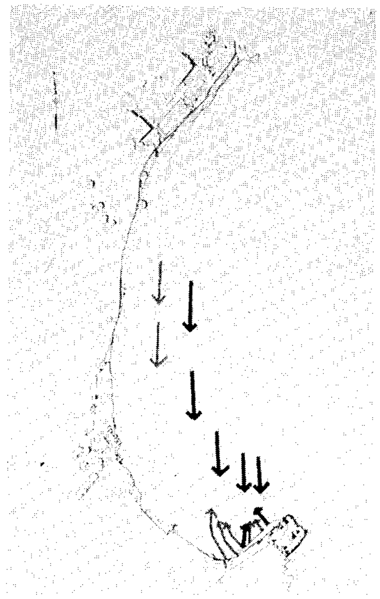
Ms. LeBlanc holds a B.S. in Civil Engineering from Merrimack College. She has been with the New England Division for five years, the last three in the Shore Protection Section of the Coastal Development Branch.



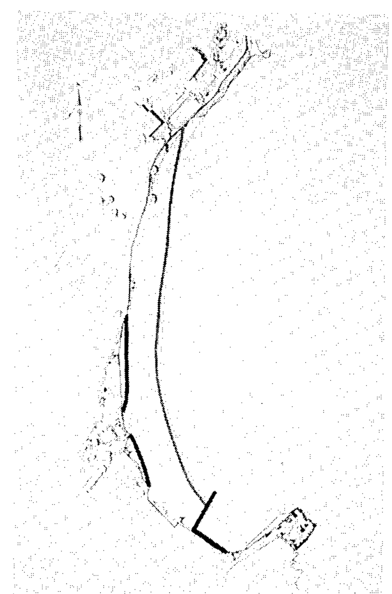
Location map for Willard Beach, Maine

Extent of erosion at Willard Beach

Southern corner, site of worst erosion



Movement of waves
and sediment



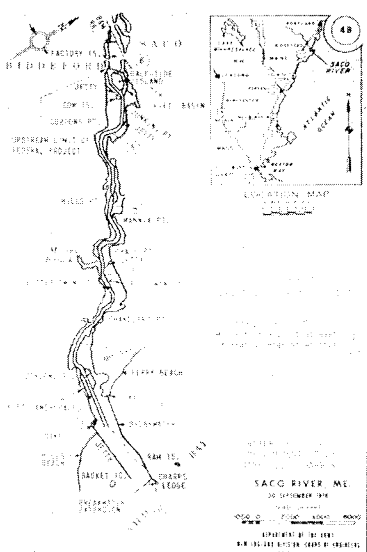
Proposed dune restoration,
sandfill, and groin structure for erosion control

Saco River Icebreaking Structures

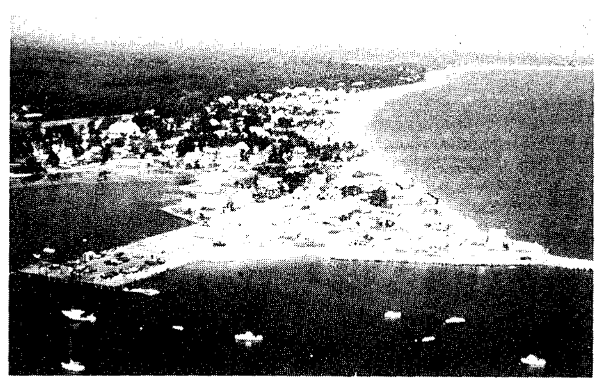
By: Michael D. Misslin, Project Manager, NED

An overview of winter navigation problems facing commercial fishermen in northern New England was presented with special emphasis on the process of designing an all-weather anchorage in the Saco River at Camp Ellis Harbor at Saco, Maine.

Mr. Misslin holds a B.S. in Civil Engineering from Tufts University and is a Master's candidate at Northeastern University. He is a Project Manager in the Coastal Development Branch of the New England Division. Prior to joining the Division staff in 1979, Mr. Misslin served as a Project Engineer with the Corps' Baltimore District and as a hydraulic engineer with the U. S. Bureau of Reclamation at the Missouri-Souris Project Office.



Location map and project map of Saco River at Camp Ellis Harbor, Maine



Camp Ellis Harbor

Anchorage completed
winter 1982-3

Upstream beach created by sand
dredged to construct anchorage

Oakland Beach Monitoring Program

By: William T. Coleman, Project Engineer, NED

Oakland Beach is located in the city of Warwick, Rhode Island, at the southern extremity of a point of land known as Horse Neck in the upper portion of Narragansett Bay, approximately ten miles south of Providence and fifteen miles north of Newport, Rhode Island.

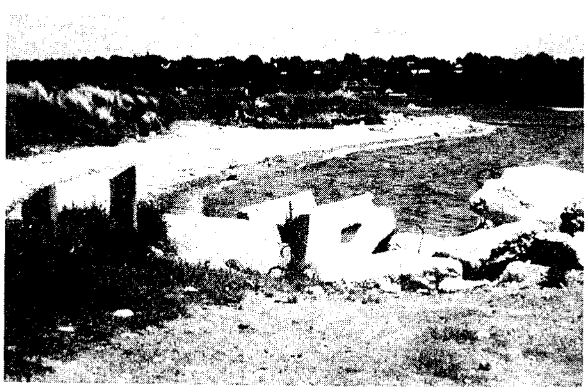
A small beach erosion control project involved raising and widening the beach above the mean high waterline by the placement of suitable sandfill, construction of intermediate and terminal groins to help compartmentalize the sand, and provisions for annual periodic beach nourishment. The project was authorized for construction by the Chief of Engineers in April 1980.

Project construction was initiated in March 1981 and completed in August 1981 at a total cost of approximately $739,000.

In December 1981, the New England Division was directed to initiate a five-year monitoring program at Oakland Beach. Work on the monitoring program started in February 1982 and has been ongoing since that time.

The presentation provided an overview of what is involved in the monitoring program, the objective of the program, and the preliminary findings to date regarding the project.

Mr. Coleman holds both a B.S. and M.S. degree in Civil Engineering from Northeastern University. He joined the New England Division staff in 1973, following several years of service with the Boston Naval Shipyard, and is a Project Engineer in the Coastal Engineering and Survey Section of the Design Branch.



East Oakland Beach and Warwick Cove before erosion control

East Oakland Beach after project was completed in August 1981

Cliff Walk Shore Restoration and Protection Project

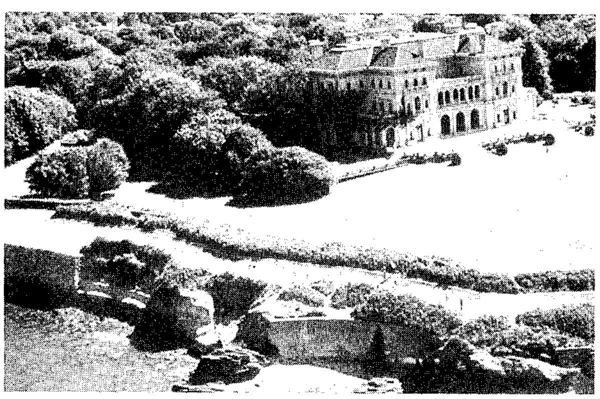
By: Robert L. Harrington, Project Manager, NED

The Cliff Walk Shore Restoration and Protection Project began with the completion of a cooperative study in 1964 and was authorized by Congress in October 1965. The purpose of the project is to protect Cliff Walk, which is the physical manifestation of a right to pass along the shore granted to the citizens of Rhode Island in the State's constitution. The walk, which has been designated a National Historic Recreational Trail, extends approximately 3.5 miles along the shore facing the Atlantic Ocean near the mouth of Narragansett Bay. The continued erosion and retreat of the cliffs, resulting from wave action and surface drainage, have been slowed by three construction projects completed since 1964. Additional protection measures were recommended in a restudy report completed in 1981, and plans and specifications have been completed on one reach in the vicinity of Salve Regina College. The design parameters, economics, alternatives, and solution for protection in that reach were discussed in detail, together with an overview of the entire project. A location map of Cliff Walk and diagrams of typical sections of its protective structures are included in Part III of these proceedings.

Mr. Harrington holds a B.S. in Civil Engineering from Northeastern University and is a registered professional engineer. Prior to joining the New England Division staff in 1974, Mr. Harrington was associated with private consulting and construction firms. He has worked on numerous flood control projects, including the Park River deep rock tunnel project in Hartford, Connecticut, and the major rehabilitation of the Bourne and Sagamore highway bridges spanning the Cape Cod Canal. He is assigned to the Project Management Branch of the Engineering Division.

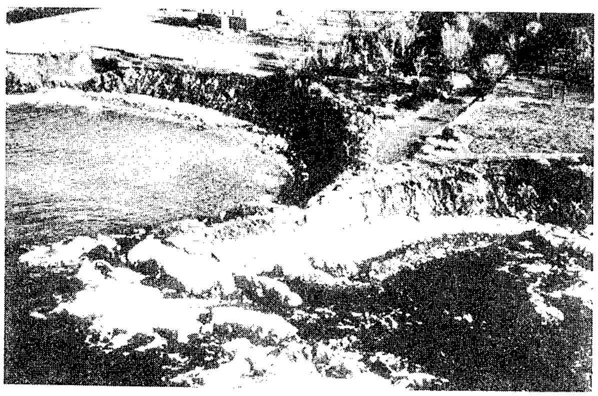
Conditions at Walk before 1970

View from Breakers Mansion looking north to Newport Beach after completion of project (1972)



View of old walls at Breakers Mansion

View south from Breakers Mansion after project completion



View of Sheeps Point
before construction

View of Sheeps Point
after construction

<u>New Bedford Harbor Hurricane Barrier*</u>

By: Joseph L. Ignazio, Chief, Planning Division, NED

Development of the New Bedford Harbor Hurricane Project, with particular emphasis on the planning of the barrier and gate structure, dates back to 1955-1958 time frame. Mr. Ignazio, who was the project engineer during the General Investigation phase, was detailed as a specific assignment the design of the 150-foot navigation gate opening. His remarks centered on the history of the project, with insight into levels of protection and uniqueness of the gates finally selected to permit closure of the large navigation opening in less than 30 minutes. A more detailed, illustrated description of the project is included in Part III of these proceedings.

Mr. Ignazio has more than 35 years of experience in engineering, design, and construction of civil works projects of various types. Over the last 20 years he has been engaged in planning of water resources of all types for the New England region. Mr. Ignazio holds three separate degrees in engineering and business management and a Masters in engineering and management. His experience spans a spectrum of efforts, including the design of hospitals; building of highways, railroad embankments and crossings; and a 24-month tour of duty with the Corps of Engineers at Fort Belvoir. Assigned to ERDL Labs in the early fifties, Mr. Ignazio was Project Manager in the development of the Armored Vehicle Assault Bridge which is currently standard equipment in Armored Divisions throughout the country.

Mr. Ignazio joined the Corps as Project Manager of the New Bedford hurricane barrier in 1955 and was later assigned various projects with the Engineering Division, followed by assignment in Comprehensive River Basin Studies. He has been the Chief of Planning Division since 1970 and ranks 4th in tenure among the Corps Planning Chiefs.

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* The full text of Mr. Ignazio's speech is included in Appendix A.

Revere Tidal Flood Control

By: Robert G. Hunt, Senior Project Manager, NED

The city of Revere, north of Boston, was one of the hardest hit areas in the Great Blizzard of '78. The 1978 storm caused tides to overtop seawalls at four locations along the 3-mile shorefront of Revere. A recurrence of the 1978 flood would cause an estimated $35 million in damages to 1400 structures and transportation arteries. The Revere Beach reservation is the largest regional beach served by public transportation. Plans to prevent future flooding in Revere include concrete walls, rock revetments, backshore embankments, and beach nourishment along the shorefront. The crescent Revere shoreline is sheltered from northeast storms by the Nahant tombolo which partially encloses the shallow waters of Broad Sound. The 80-year history of beach erosion and seawall repairs was used to formulate beach designs and nourishment plans. The 1978 100-year storm was 10.3 feet above mean sea level, recorded at Boston, and still-water tide levels were up to 10 feet deep as waves broke on the seawalls. Three projects planned to protect Revere are estimated to cost $20 to $25 million, providing an average annual benefit-to-cost ratio of 2.0 to 1.

Mr. Hunt holds a B.S. in Agricultural Engineering from the University of Maine and an Associate in Business Administration from Middlesex Community College. His more than fifteen years with the Corps of Engineers include three years as a Captain with the North Pacific Division and two years as a civilian with the Detroit District. He is a senior Project Manager in the Planning Division.

Bay of Fundy Tidal Power Study: Overview

By: Joseph L. Ignazio, Chief, Planning Division, NED

The Bay of Fundy Tidal Power Study, soon to get under way, is an extensive study to assist the New England coastal states and the Canadian Maritime Provinces in determining the effects of a tidal power barrier closure in the Upper Mianus Bay of Fundy by the government of Nova Scotia. The tidal barrier closure is reported to produce increases in normal tidal ranges from 6 to 18 inches. Mr. Ignazio outlined concerns held by the Corps, some of the study plans that are being developed to perform a verification of the tidal impacts, and, most importantly, impacts to the natural environment and physical resources along the shoreline of the Gulf of Maine. In the initial study stage emphasis will be given to math modelings and the establishment of several environmental studies. This important tidal power project could provide large energy benefits to the northeast region of the United States and Maritime Provinces.

Bay of Fundy Tidal Power Study: Proposed CERC Role

By: Dr. James R. Houston, CERC, WES

Dr. Houston discussed the possible CERC participation in a Bay of Fundy Tidal Power Study. Initial CERC participation would involve numerical modeling of the Gulf of Maine and Bay of Fundy complex to determine the credibility of a numerical modeling study, performed by Dr. D. A. Greenburg for the Canadians, which predicted significant impacts of barriers on the Bay of Fundy tidal ranges in the United States. States that would be impacted have called for an independent study by the United States to confirm or deny Dr. Greenburg's calculations. CERC also would establish a panel of experts from Corps Laboratories, the New England Division of the Corps, local state agencies, and experts from universities and private industry to develop a comprehensive study plan that would consider potential oceanographic, coastal, and environmental impacts.

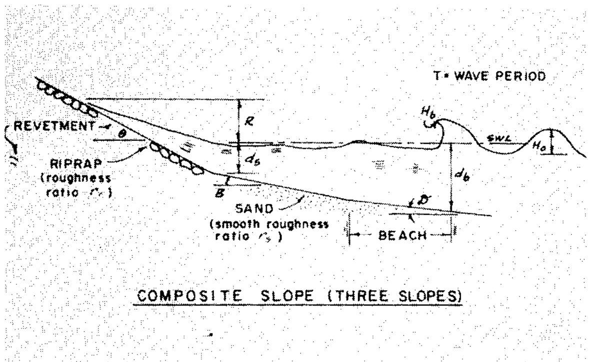
Dr. Houston is Chief, Research Division, Coastal Engineering Research Center (CERC), at Waterways Experiment Station (WES). He has a doctorate in Engineering Mechanics from the University of Florida. Since 1971 he has performed studies at WES on tsunami generation, propagation, and runup; waves generated by explosions; harbor resonance problem; scour during construction in the ocean; and numerical modeling of waves, currents, and sediment transport. He is a recipient of the Department of the Army Research and Development Achievement Award.

Problems Associated with Current Coastal Engineering Criteria

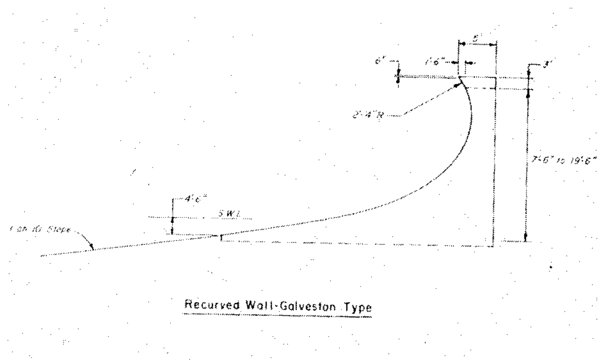
By: Anthony R. Riccio, Project Engineer, NED

Problems associated with current coastal engineering design criteria were discussed, with particular emphasis on wave runup and overtopping analyses and beach erosion control phenomena.

Mr. Riccio holds a B.S. in Civil Engineering from Tufts University. He joined the New England Division staff in 1977 as a Project Engineer in the Design Branch, following two years as a co-op employee while attending college.

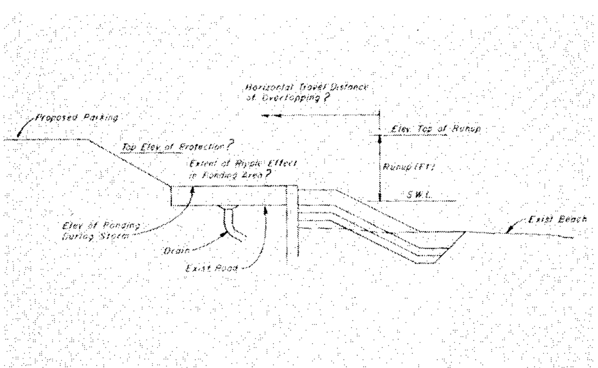


a. Composite slope



b. Recurved wall

Current runup evaluation methods



Questions proposed during Revere Beach, Massachusetts, erosion protection project

Recurring scarp at Sherwood Island, Westport, Connecticut

Dredged Material Management in New England and Automated Monitoring of Dredge Disposal Operations

By: Christopher J. Lindsay and Steven W. Congdon, NED

Dredged material management in the New England Division is attuned to regulatory mandates and is significantly supported by scientific findings and contributions of the Division's field monitoring activities. In 1977 the Division formalized a Disposal Site Monitoring System, acronym DAMOS, for the purposes of monitoring open water disposal of dredged materials and gaining an awareness of resultant impacts. Being responsive to everchanging regulatory dictates, DAMOS has necessarily been developmental, incorporating state-of-the-art instrumentation and research concurrent with disposal site monitoring activities. The program is structured but dynamic in that the design of each operational phase is predicated on the findings and conclusions of previous observations.

The Division is currently involved in two long-term research programs being conducted in Long Island Sound sponsored by the Waterways Experiment Station. The Field Verification Program (FVP) is a joint study by the Corps and EPA to verify the predictive accuracy of laboratory testing by determining actual impacts at open water disposal sites. The second study, examining the geotechnical efficiency of capping, is being conducted by WES and NED. Maintenance dredged materials from the Federal channels at Black Rock Harbor and New Haven Harbor, Connecticut, are being used in each study. Specialized instrumentation is used to assess the physical properties of the dumped sediment in relation to the natural sediment; in addition, a computer-aided system which allows operators to dump accurately within a small area is being successfully employed. NED managers and DAMOS scientists are participating in the design of these programs, while the Division is providing the field support via DAMOS. It is expected that the scientific conclusions from these studies will contribute significantly to future dredged material management planning.

Mr. Lindsay holds a B.S. in Civil Engineering from the University of Connecticut. He is a civil engineer in the Dredged Material Management Section and has been with the Corps for six years. Mr. Congdon received a B.S. in Natural Resources at the University of Rhode Island. He is a Physical Scientist in the Dredged Material Management Section. Prior to joining the New England Division staff about three months ago, Mr. Congdon served more than three years with the Detroit District.

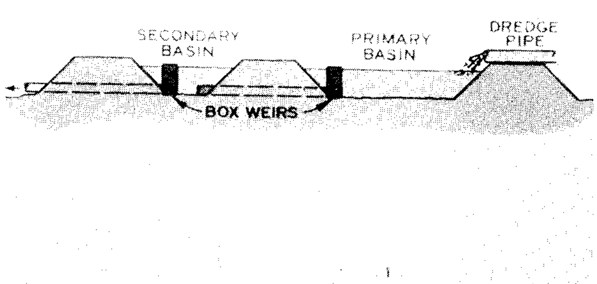
<u>Long Island Sound Dredged Material Containment Study</u>

By: Richard F. Quinn, Project Manager, NED

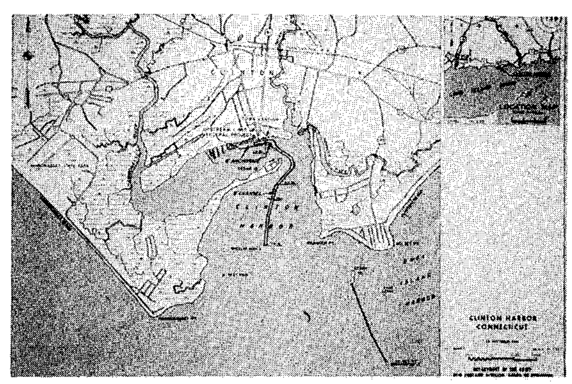
The Long Island Sound Dredged Material Containment Study was originally authorized in December 1977. We have investigated over 300 sites to date, including deepwater islands, shallow-water islands, shoreline extension projects, marsh creation projects, and subaqueous borrow pits. Projects presently under consideration that are somewhat supported by local and State interests include all but deepwater island projects.

We are presently finalizing studies at the proposed containment sites that survived several screening iterations in preparation for submission of our draft report, scheduled for completion in September 1984. At this stage in planning it appears that at least four sites are feasible for disposal. These sites will be capable of storing 14 million cubic yards of dredged material at a cost of $40,000,000.

Mr. Quinn holds a B.S. in Civil Engineering and an M.S. in Sanitary Engineering from Northeastern University. A registered professional engineer, he has been with the New England Division since 1971 holding a variety of positions within the Permits and Basin Management Branches. Mr. Quinn has been Project Manager for the Long Island Sound Dredged Material Containment Study since September 1980.

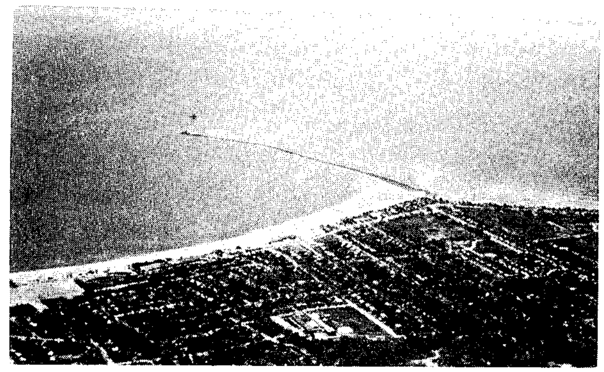


Schematic of dredged material containment facility

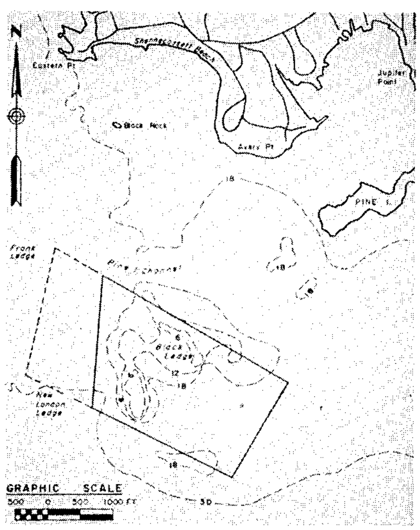


Proposed marsh disposal site at Clinton Harbor, Connecticut

Saltwater marsh at present Clinton Harbor



Penfield Reef, Black Rock Harbor, Connecticut, proposed containment site



Proposed containment site, Black Ledge, Connecticut

Poster Session

Nearshore Research at Woods Hole Oceanographic Institute, by Dr. D. G. Aubrey, Engineering Geologist, WHOI

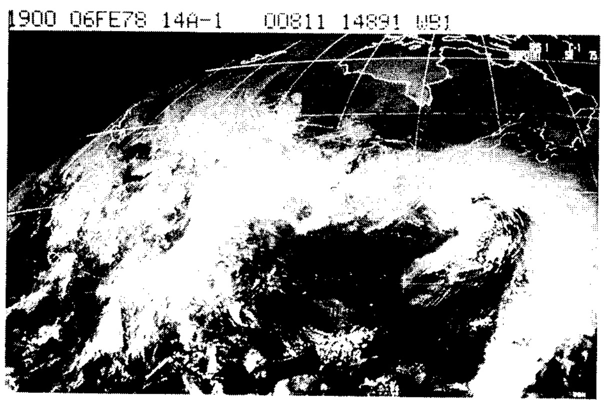
The presentation focused on several aspects of nearshore research in progress at the Woods Hole Oceanographic Institute. Tidal inlet numerical modeling and associated field verification efforts were examined, along with the study of beach erosion along the U. S. east coast, using quantitative statistical techniques for intercomparison of beach response at distributed coastal stations. Recent trends in U. S. and global sea levels were presented, with emphasis on engineering implications of such sea level rise. Finally, wave research in the New England coastal zone was detailed, with emphasis on data requirements and our efforts to alleviate the information vacuum.

Dr. David G. Aubrey is presently an Associate Scientist in the Department of Geology and Geophysics at the Woods Hole Oceanographic Institute. Although primarily involved with research, he has taught several courses and advised Ph. D. candidates as part of the Joint Program of the Massachusetts Institute of Oceanography and the Woods Hole Oceanographic Institute. Dr. Aubrey received his Ph. D. from Scripps Institution of Oceanography. Prior to that he obtained a B.S. in Civil Engineering and a B.S. in Geological Sciences from the University of Southern California.

The Blizzard of '78, by
John J. Caffrey, Emergency Manager, NED

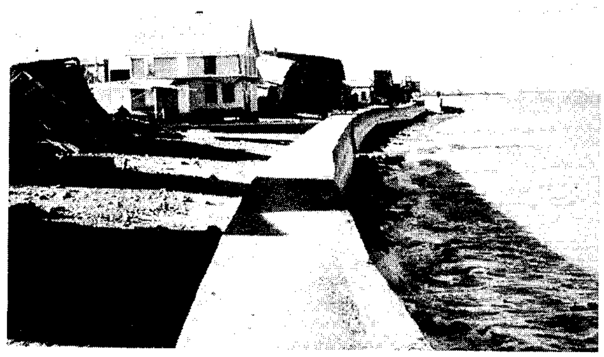
Cooperation and coordination between public agencies was the substance of the dramatic response to the 6-7 February 1978 blizzard. The around-the-clock snow removal battle saw the New England Division committing every type of snow-fighting equipment available to assist 280 communities in Massachusetts, Rhode Island, and Connecticut. The Division expended more than $15 million to 2,200 contractors utilizing 4,500 pieces of equipment to clear more than 7,000 miles of roadways.

Mr. Caffrey holds a B.S. in Civil Engineering from Northeastern University. The U. S. Marine veteran is a registered professional engineer and a registered land surveyor. He has been with the New England Division since 1967 and Emergency Manager since 1969.



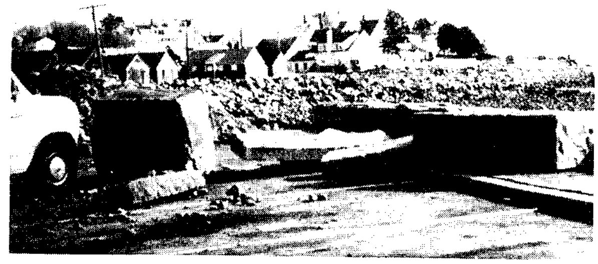
Satellite view of U. S. showing intensity of first day of blizzard, 6 February 1978

The aftermath

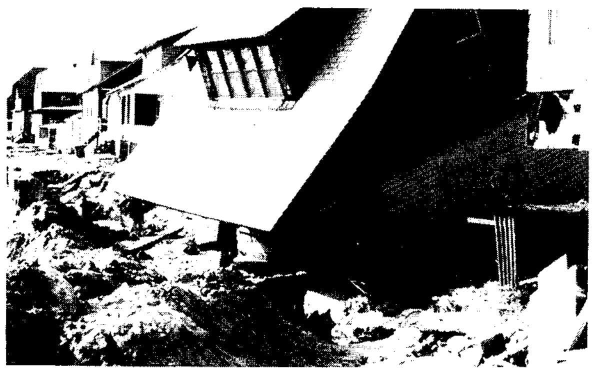


Effects of seawall overtopping and tidal surge

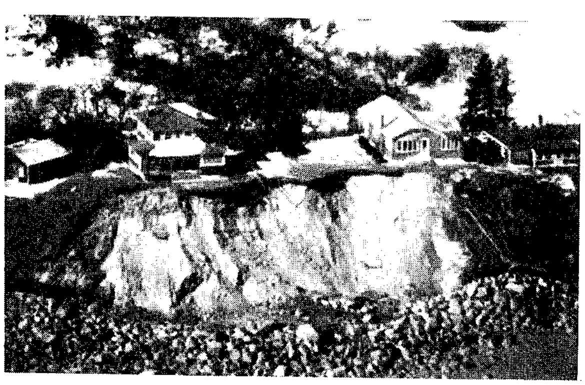
Wave-deposited sand and cobbles on the streets of Winthrop, Massachusetts



Failed revetment in southern Maine



Effects of seawall breakage and subsequent erosion of house foundation by waves



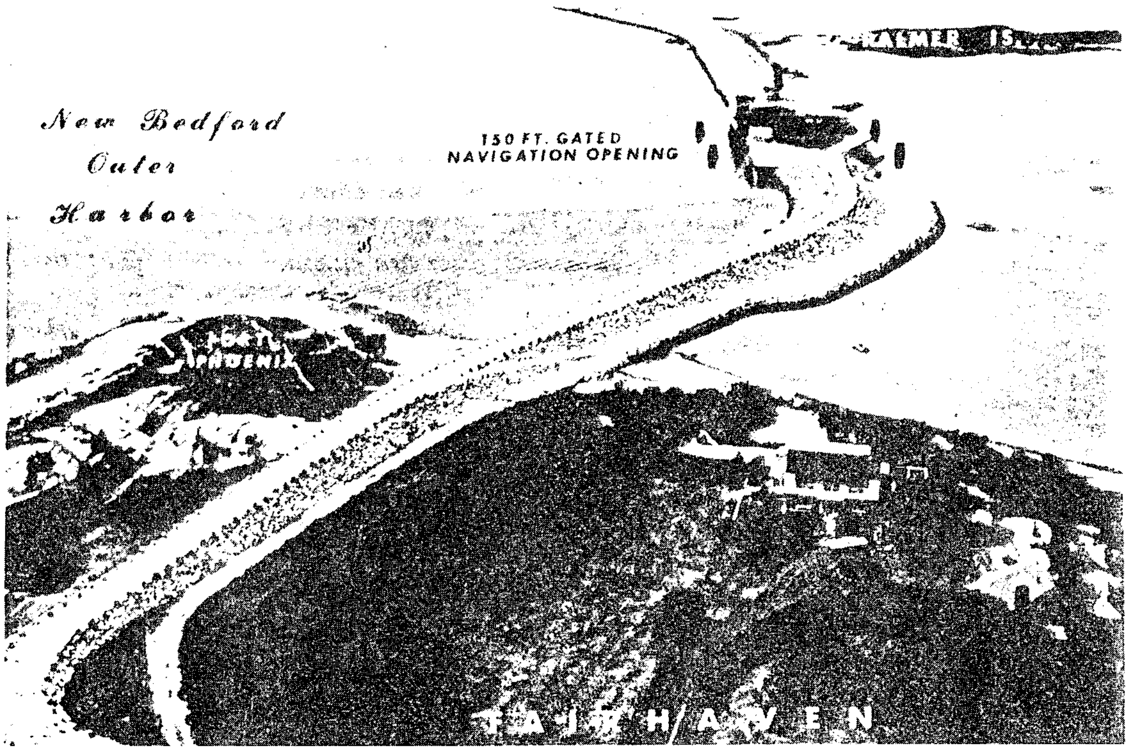
Base of cliffs removed by wave action

Pushing up sand to create emergency protection against future storms

PART III: FIELD TRIP DESCRIPTIONS, 19 OCTOBER 1983

This part presents descriptions of the three NED projects toured by CERB Meeting participants--the New Bedford Hurricane Barrier, Cliff Walk, the Cape Cod Canal--and gives a brief summary of the functions of the Woods Hole Oceanographic Institution, the first field trip stop. A brief description of the Cape Cod Canal tugboat sinking poster session is also included.

James G. Doucakis of the Coastal Development Branch of the New England Division coordinated the field trip activities for the meeting. Mr. Doucakis holds a B.S. in Civil Engineering from Northeastern University and has been with the Division for four years. He is a Project Manager in the Shore Protection Section.



HURRICANE PROTECTION PROJECT

NEW BEDFORD, FAIRHAVEN AND ACUSHNET, MASS.

Condition of Improvement, 30 September 1976

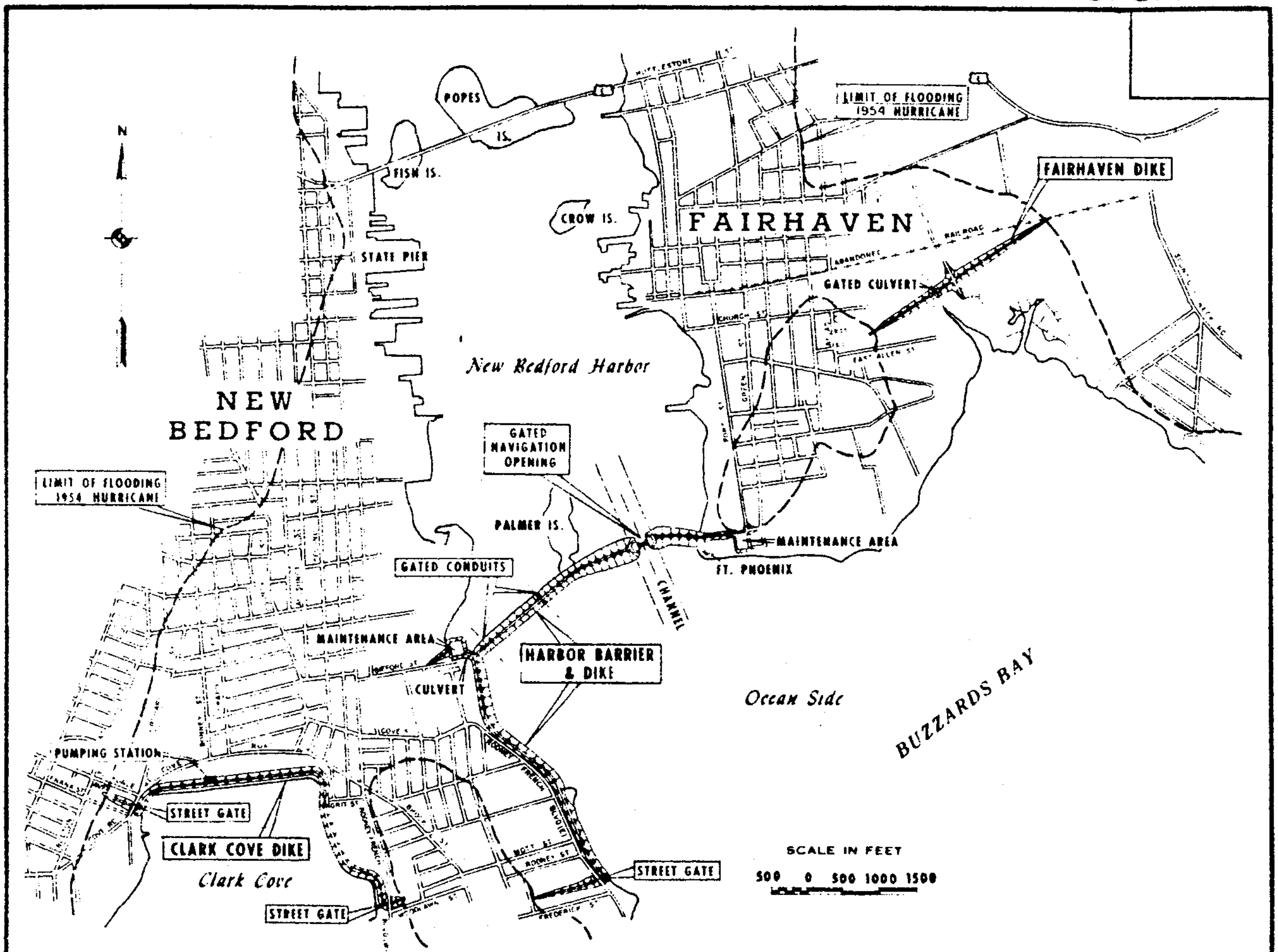
EXISTING PROJECT: Authorized by Flood Control Act of 1958, the project provides for the construction of an earth-fill dike with rock faces, a gate opening for navigation and appurtenant works, across the main harbor in New Bedford, an earth-fill rock-faced dike and concrete gravity wall including stoplog structure in the Clark Cove area and an earth-fill dike with rock facing on top and seaward slope in the Fairhaven section. Estimated cost is $17,980,000 for construction and $620,000 for lands, rights-of-way, and relocations, a total of $18,600,000.

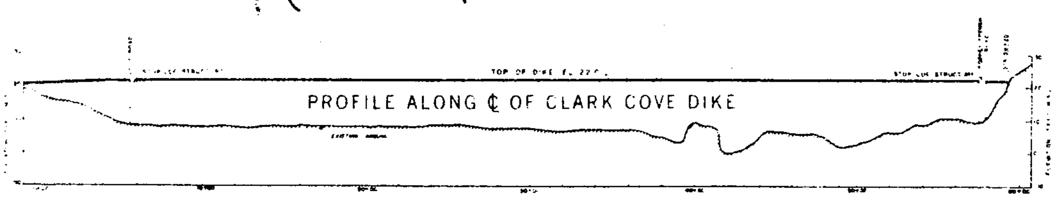
LOCAL COOPERATION: Local interests are required to contribute 30 percent of the first cost of the project, including the value of lands, easements and rights-of-way; contribute the capitalized value of annual maintenance and operation ($1,520,000) for the main harbor barrier; hold and save the United States free from damages due to the construction works; and maintain and operate all the works, except the main harbor barrier after completion, in accordance with regulations prescribed by the Secretary of the Army. Total estimated costs for all requirements of local cooperation amount to $7,100,000.

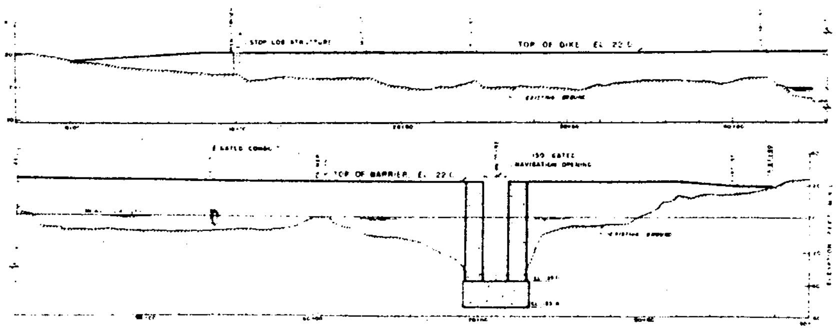
PROGRESS: Project is essentially complete and is operational. Construction of the pumping station was initiated in October 1962 and completed in June 1964. Construction of the barrier and appurtenances was initiated in October 1962 and completed in January 1966.

COST OF NEW WORK TO DATE: $18,588,700, of which $17,972,300 was for construction and $616,400 for lands, damages, rights-of-way, and relocations. Total cost to date includes $7,096,600 in non-Federal costs.

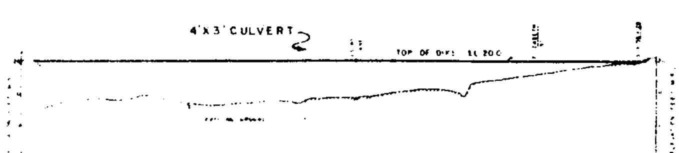
CORPS OF ENGINEERS U. S. ARMY







PROFILE ALONG ℄ OF NEW BEDFORD HARBOR BARRIER



PROFILE ALONG ℄ OF FAIRHAVEN DIKE

HURRICANE PROTECTION PROJECT

NEW BEDFORD - FAIRHAVEN, MASS.

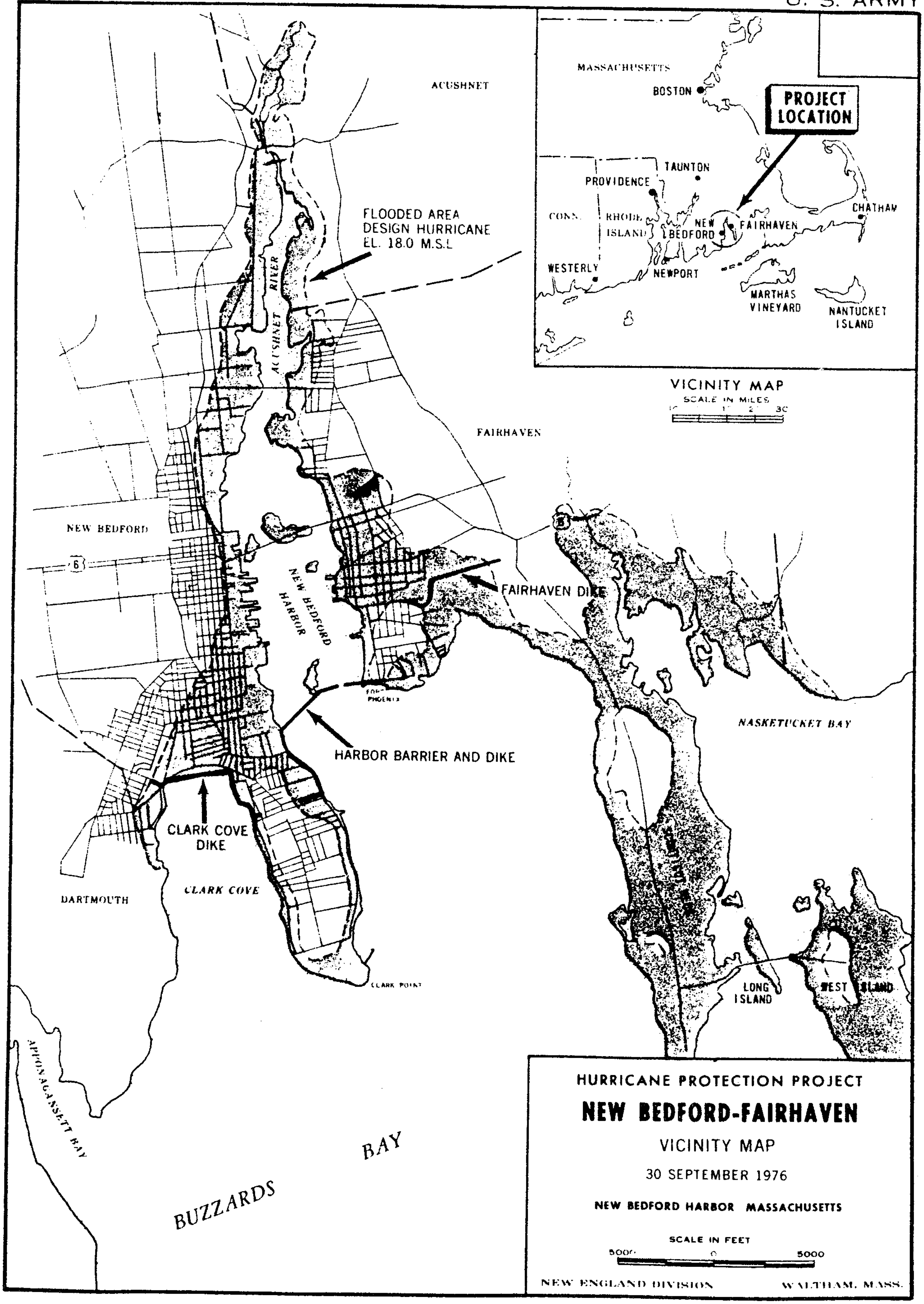
GENERAL PLAN

NEW BEDFORD HARBOR MASSACHUSETTS

30 SEPTEMBER 1976

NEW ENGLAND DIVISION WALTHAM, MASS.

CORPS OF ENGINEERS U. S. ARMY



HURRICANE PROTECTION PROJECT

NEW BEDFORD-FAIRHAVEN

VICINITY MAP

30 SEPTEMBER 1976

NEW BEDFORD HARBOR MASSACHUSETTS

SCALE IN FEET

5000 0 5000

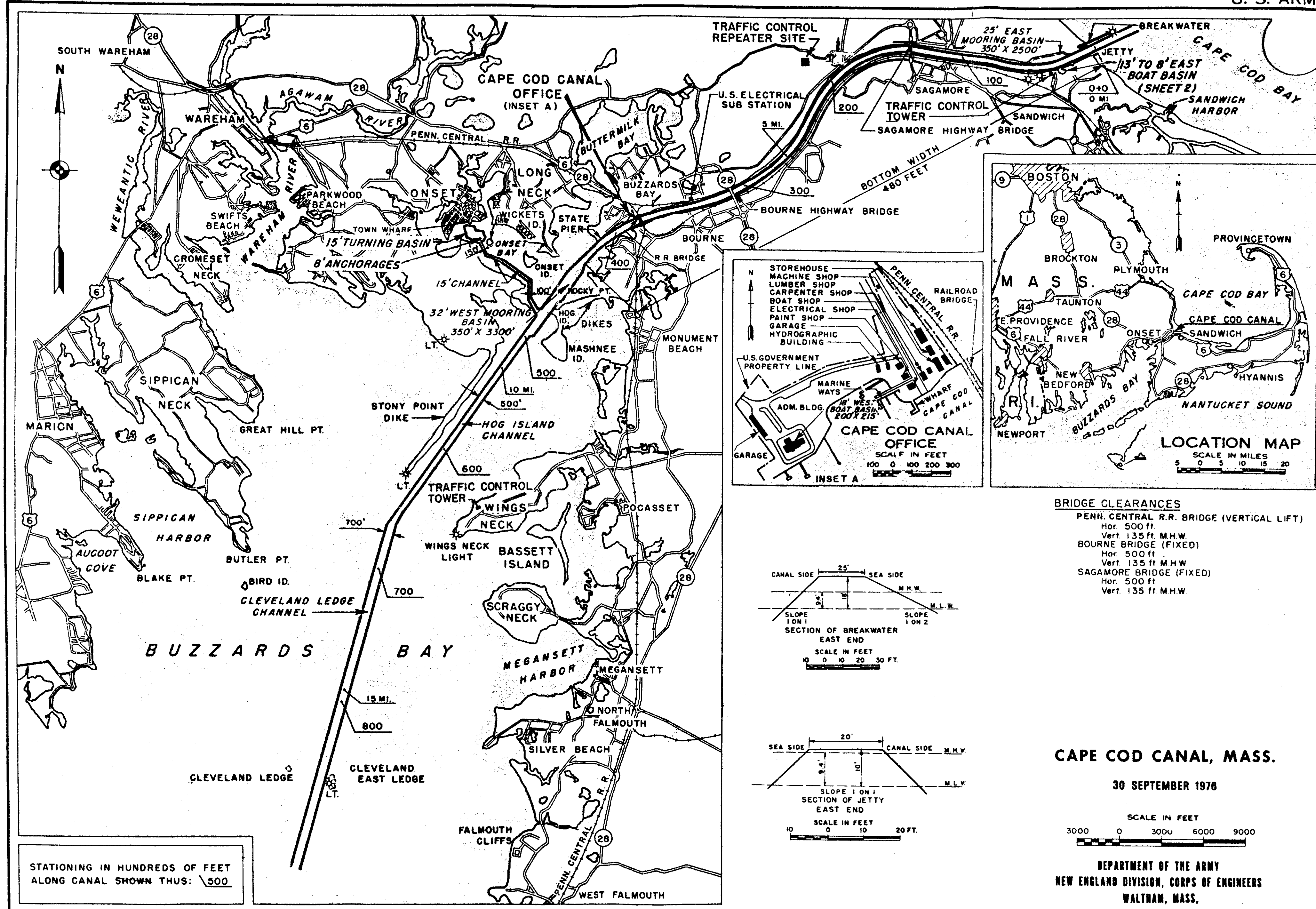
NEW ENGLAND DIVISION WALTHAM, MASS.

Cape Cod Canal, Massachusetts

CONDITION OF IMPROVEMENT: 30 SEPTEMBER 1976

EXISTING PROJECT: Adopted 21 January 1927, supplemented by Public Works Acts of 1933 and 1935, and River and Harbor Acts of 1935, 1954 and 1958. Provides for the purchase of the Cape Cod Canal, including a 600-foot jetty and a 3,000-foot breakwater at the east end of the canal; for an open canal 32 feet deep with a width of 540 feet in the land cut, 7.7 miles long, 500 feet wide in a straight channel in Buzzards Bay to Wings Neck and 700 feet wide beyond Wings Neck, total length of canal 17.5 miles; mooring basins consisting of the west mooring basin on the south side near Hog Island about 3,300 feet long, about 350 feet wide and 32 feet deep, and the east mooring basin on the north side of the channel at Sandwich, about 2,500 feet long, about 350 feet wide and 25 feet deep; the construction of two fixed highway bridges having a horizontal clearance of 500 feet, and a vertical clearance of 135 feet at mean high water; the construction of a vertical lift railroad bridge with a 500-foot span and 135-foot clearance above mean high water when the span is raised; an improved lighting system; other accessory and minor features which may be deemed necessary and to be in accordance with plans approved by the Chief of Engineers, which include a dike extending southwesterly 10,700 feet from Stony Point, a dike between Hog Island and Mashnee Islands, a dike between Hog Island and Rocky Point, a small East Boat Basin, 13 feet deep, on the south side of the canal in Sandwich, and a small West Boat Basin, 18 feet deep, on the north side of the canal westerly of the railroad bridge; a harbor of refuge for small vessels by dredging a channel 15 feet deep, 100 feet wide, from the Cape Cod Canal into Onset Bay in the vicinity of Wickets Island to the town wharf at the village of Onset,

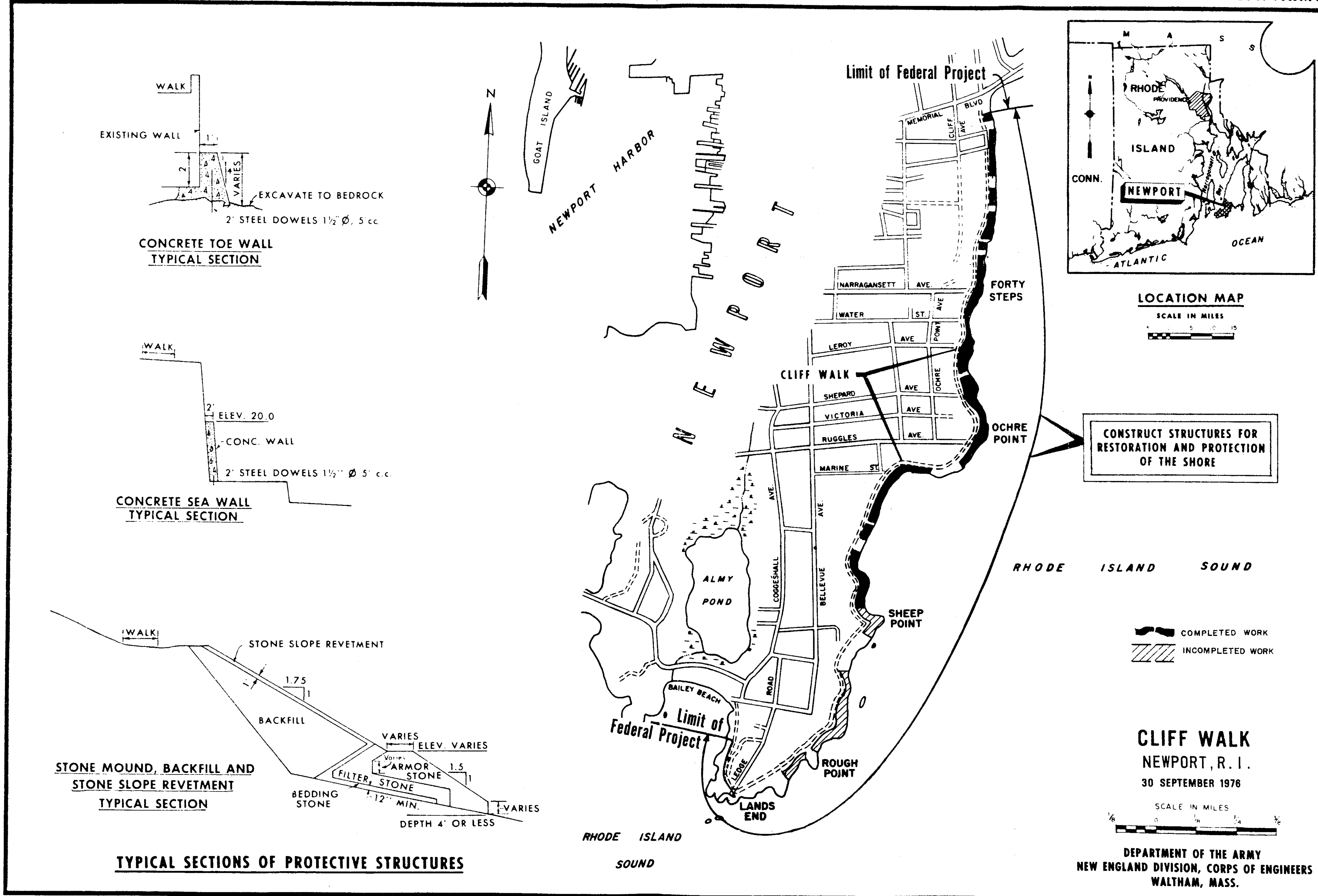
EXISTING PROJECT:	distance 0.6 miles, for enlargement of the 15-foot turning basin at the town wharf, and for dredging east and west anchorages adjacent to the 15-foot channel in Onset Bay to depths of 8 feet. An additional area in the East Boat Basin, approximately 4.3 acres in area and 8 feet deep extending south and southwest from the existing 13-foot East Boat Basin.
PROGRESS:	Existing project was completed in April 1963 with completion of the 8-foot East Boat Basin extension. However, proposed recreational facilities have been built since that time and additional recreational facilities remain to be constructed. Major rehabilitation of the Bourne Highway Bridge was completed in December 1965. Minor rehabilitation of the breakwaters was completed in October 1963.
COST OF NEW WORK:	$32,279,325 including local cash contribution of $115,432.
MEAN RANGE OF TIDE:	9.4 feet in Cape Cod Bay, Cape Cod Canal Entrance; 4.0 feet in Buzzards Bay, Cape Cod Canal Entrance.
DATUM PLANE:	Mean low water


TRAFFIC CONTROL
REPEATER SITE
25' EAST
MOORING BASIN
350' X 2500'
BREAKWATER
CAPE COD BAY
JETTY
13' TO 8' EAST
BOAT BASIN
(SHEET 2)
SANDWICH
HARBOR
SOUTH WAREHAM
CAPE COD CANAL
OFFICE
(INSET A)
U.S. ELECTRICAL
SUB STATION
SAGAMORE
TRAFFIC CONTROL
TOWER
SANDWICH
SAGAMORE HIGHWAY BRIDGE
AGAWAM
RIVER
WAREHAM
PENN. CENTRAL R.R.
BUTTERMILK
BAY
WEWEANTIC RIVER
WAREHAM RIVER
LONG
NECK
BUZZARDS
BAY
BOTTOM WIDTH
480 FEET
PARKWOOD
BEACH
ONSET
SWIFTS
BEACH
WICKETS
ID.
STATE
PIER
BOURNE HIGHWAY BRIDGE
TOWN WHARF
15' TURNING BASIN
ONSET
BAY
BOURNE
CROMESET
NECK
8' ANCHORAGES
ONSET
ID.
R.R. BRIDGE
15' CHANNEL
ROCKY PT.
32' WEST MOORING
BASIN
350' X 3300'
HOG
ID.
DIKES
LT.
MASHNEE
ID.
MONUMENT
BEACH
SIPPICAN
NECK
STONY POINT
DIKE
HOG ISLAND
CHANNEL
MARION
GREAT HILL PT.
LT.
TRAFFIC CONTROL
TOWER
WINGS
NECK
POCASSET
SIPPICAN
HARBOR
WINGS NECK
LIGHT
BASSETT
ISLAND
AUCOOT
COVE
BUTLER PT.
BLAKE PT.
BIRD ID.
CLEVELAND LEDGE
CHANNEL
SCRAGGY
NECK
BUZZARDS BAY
MEGANSETT
HARBOR
MEGANSETT
NORTH
FALMOUTH
SILVER BEACH
CLEVELAND LEDGE
CLEVELAND
EAST LEDGE
LT.
FALMOUTH
CLIFFS
PENN. CENTRAL R.R.
WEST FALMOUTH
0+0
0 MI.
100
200
5 MI.
300
400
500
10 MI.
500'
600
700'
700
15 MI.
800
STATIONING IN HUNDREDS OF FEET
ALONG CANAL SHOWN THUS: 500
STOREHOUSE
MACHINE SHOP
LUMBER SHOP
CARPENTER SHOP
BOAT SHOP
ELECTRICAL SHOP
PAINT SHOP
GARAGE
HYDROGRAPHIC
BUILDING
PENN. CENTRAL R.R.
RAILROAD
BRIDGE
U.S. GOVERNMENT
PROPERTY LINE
MARINE
WAYS
18' WEST
BOAT BASIN
200' X 215'
ADM. BLDG.
WHARF
CAPE COD
CANAL
GARAGE
CAPE COD CANAL
OFFICE
SCALE IN FEET
100 0 100 200 300
INSET A
BOSTON
BROCKTON
PLYMOUTH
PROVINCETOWN
MASS.
TAUNTON
CAPE COD BAY
E. PROVIDENCE
ONSET
CAPE COD CANAL
SANDWICH
FALL RIVER
NEW
BEDFORD
HYANNIS
R.I.
BUZZARDS BAY
NANTUCKET SOUND
NEWPORT
LOCATION MAP
SCALE IN MILES
5 0 5 10 15 20
BRIDGE CLEARANCES
PENN. CENTRAL R.R. BRIDGE (VERTICAL LIFT)
Hor. 500 ft.
Vert. 135 ft. M.H.W.
BOURNE BRIDGE (FIXED)
Hor. 500 ft.
Vert. 135 ft. M.H.W.
SAGAMORE BRIDGE (FIXED)
Hor. 500 ft.
Vert. 135 ft. M.H.W.
CANAL SIDE
25'
SEA SIDE
M.H.W.
M.L.W.
SLOPE
1 ON 1
SLOPE
1 ON 2
SECTION OF BREAKWATER
EAST END
SCALE IN FEET
10 0 10 20 30 FT.
SEA SIDE
20'
CANAL SIDE
M.H.W.
M.L.W.
SLOPE 1 ON 1
SECTION OF JETTY
EAST END
SCALE IN FEET
10 0 10 20 FT.
CAPE COD CANAL, MASS.
30 SEPTEMBER 1976
SCALE IN FEET
3000 0 3000 6000 9000
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

Cliff Walk
Newport, Rhode Island

CONDITION OF IMPROVEMENT: 30 SEPTEMBER 1976

EXISTING PROJECT:	Authorized by River and Harbor Act of 27 October 1965. Provides for construction of improvement for shore protection, extending from the west end of Newport Beach to the east end of Bailey Beach, a distance of about 18,000 feet, consisting of intermittent reaches of backfill, dumped riprap, stone mounds, stone breakwaters, concrete toe walls, concrete sea walls, concrete parapet walls, grading and surfacing Cliff Walk, and for providing drainage facilities.
PROGRESS:	Construction of 9,200 feet of shore protection north of Sheep Point was completed in September 1972. The remaining 8,800 feet south of Sheep Point to Bailey Beach was placed in the inactive category due to the lack of local funds.
COST OF NEW WORK:	$1,274,491 including $984,000 of contributed funds.
MEAN RANGE OF TIDE:	3.5 feet.
DATUM PLANE:	Mean low water


WALK
EXISTING WALL
1'
2
VARIES
EXCAVATE TO BEDROCK
2' STEEL DOWELS 1½" Ø, 5' c.c.
CONCRETE TOE WALL
TYPICAL SECTION
WALK
2'
ELEV. 20.0
CONC. WALL
2' STEEL DOWELS 1½" Ø 5' c.c.
CONCRETE SEA WALL
TYPICAL SECTION
WALK
STONE SLOPE REVETMENT
1.75
1
BACKFILL
VARIES
ELEV. VARIES
ARMOR STONE
1.5
1
FILTER STONE
BEDDING STONE
12" MIN.
VARIES
DEPTH 4' OR LESS
STONE MOUND, BACKFILL AND
STONE SLOPE REVETMENT
TYPICAL SECTION
TYPICAL SECTIONS OF PROTECTIVE STRUCTURES
N
GOAT ISLAND
NEWPORT HARBOR
NEWPORT
Limit of Federal Project
MEMORIAL BLVD
CLIFF AVE
NARRAGANSETT AVE.
WATER ST.
LEROY AVE
POINT AVE
FORTY STEPS
CLIFF WALK
SHEPARD AVE
VICTORIA AVE
RUGGLES AVE.
OCHRE
MARINE ST.
OCHRE POINT
CONSTRUCT STRUCTURES FOR RESTORATION AND PROTECTION OF THE SHORE
ALMY POND
COGGESHALL AVE.
BELLEVUE AVE.
SHEEP POINT
BAILEY BEACH
ROAD
Limit of Federal Project
LEDGE
ROUGH POINT
LANDS END
RHODE ISLAND SOUND
RHODE ISLAND SOUND
M A S S
RHODE ISLAND
PROVIDENCE
CONN.
NEWPORT
ATLANTIC OCEAN
LOCATION MAP
SCALE IN MILES
COMPLETED WORK
INCOMPLETED WORK
CLIFF WALK
NEWPORT, R. I.
30 SEPTEMBER 1976
SCALE IN MILES
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

Woods Hole Oceanographic Institution
Woods Hole, Massachusetts

The Woods Hole Oceanographic Institution (WHOI) was charted in 1930 as a private, nonprofit organization engaged in ocean research. The Institution's scientific departments are biology, chemistry, geology and geophysics, physical oceanography, and ocean engineering. The annual operating budget is about $40 million, with 800 year-round employees.

WHOI is moderately supported by Federal funds, but also depends upon the generosity of individuals, foundations, and corporations to support educational activities, specialized research, and suitable facilities. The facility has a fleet of five vessels to study past and present ocean configurations and investigate the vast resources of the ocean floor.

Poster Session

Cape Cod Canal Tugboat Sinking,
by Frank A. Morris, Cape Cod Canal

The sinking of the 104-foot-long tug MORTON S. BOUCHARD, JR., in the Cape Cod Canal on April 11, 1983, presented a unique salvage challenge to the Corps and the tug's owner. The vessel was en route from New York to Revere, Massachusetts, towing a 300-foot-long, 64-foot-wide barge laden with 8,400 tons of gasoline at the time of the accident. The tug was carrying approximately 80,000 gallons of diesel fuel at the time of the sinking. Mr. Morris' presentation touched on control center activities at the time of the incident, rescue operations to recover the crew and barge, procedures to minimize oil pollution, equipment and methods to right and raise the 432-ton tug in the strong reversing currents of the Cape Cod Canal, and the horrendous coordination activities involved.

Mr. Morris is a registered professional engineer in Massachusetts, with a B.S. degree in Civil Engineering from Northeastern University. For the past nine years he has served as Assistant Engineer in Charge of the Cape Cod Canal. With background in marine-related activities, including hydrographic surveys, underwater investigations, and tugboat operations, he has been involved with the recovery and relocation of vessels of all sizes and types from waters in and around the canal. Mr. Morris' 21-year career with the Corps also includes extensive experience as Project Engineer for design and construction of public facilities, Emergency Operations Coordinator for removal of ice jams and other flood-related problems, and Chief Engineer for restoration of the destroyed 19-city-block area in Chelsea, Massachusetts, after the 1973 conflagration.

PART IV: ABSTRACTS OF PRESENTATIONS OF 20 OCTOBER 1983

New England Division Research Needs*

By: Lawrence A. Blake, Research and Development Coordinator, NED

New England Division technical needs that can be addressed by Corps research expertise were discussed. Emphasis was placed on the sheltered nature of the region's coastal areas and the lack of current research for this type of coastline.

Mr. Blake holds a B.S. in Civil Engineering from Southeastern Massachusetts University and serves as the New England Division's Value Engineering Officer as well as Research and Development Coordinator. A registered professional engineer, Mr. Blake is actively working towards his Certified Value Specialist certificate. He has been with the New England Division since 1977, following three years with the New York District.

NED TECHNICAL NEEDS

- COLLECT DATA BASES
- ACCESS HARDWARE
- ADAPT EXISTING PRODUCTS
- MONITOR AND VERIFY EXISTING PRODUCTS
- DEVELOP NEW PRODUCTS
- DEVELOP HARDWARE

Categories of researchable needs

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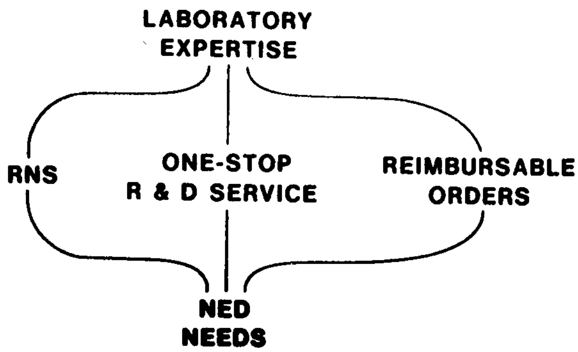
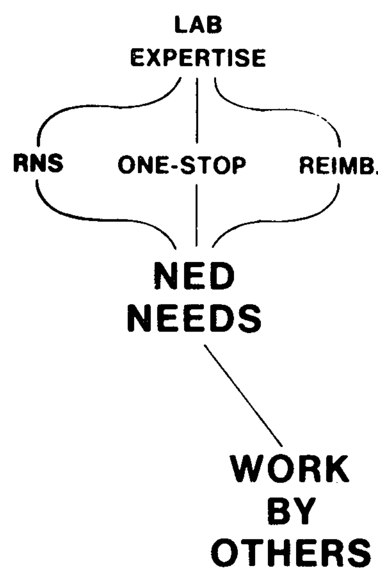
* The full text of Mr. Blake's speech is included in Appendix A.



Sources of laboratory solutions
to NED needs



Other solutions to
NED needs

Coastal High-Hazard Zone and Damage Mitigation Measures: Local Perspective of Engineering Research Needs

By: Dr. Redmond Clark, Mass. Dept. of Environmental Management
Mr. William Richardson, Anderson-Nichols

This presentation featured an overview of coastal geographic types in Massachusetts, including barrier beaches, developed shores, and dune systems, and discussed coastal storm damage and analyzed protection measures in these areas. Storm hazard modeling--including ocean waves/storm surge; interaction with landforms/erosion; land use/property values/risk exposure; qualification of risk and values; evaluation of structural/nonstructural options; and design life vs. economic life vs. risk value vs. cost--and its application were also discussed. The presentation outlined the needs for additional research, particularly in the areas of bringing broken wave heights ashore through V-zone, overtopping of walls and backshore erosion, and set-back requirements.

Mr. Richardson is a Senior Coastal Planner/Designer with the Boston-based consulting firm of Anderson-Nichols. He holds a B.A. in Environmental Planning and a B.S. in Landscape Architecture, both from the Rhode Island School of Design. He has a broad background in coastal planning, urban design, and landscape architecture and has firsthand experience with storm damage and hazard mitigation measures in high-hazard coastal areas. Mr. Richardson has been a guest lecturer at Rhode Island School of Design, the University of Rhode Island, Harvard Graduate School of Design, and Boston University.

Dr. Clark has recently begun working for the State of Massachusetts Department of Environmental Management. He received a Ph. D. in Sediment Transport Modeling from Southern Illinois University, taught at Elmhurst College in Illinois, and was Professor of Environmental Sciences at Boston University. From 1979-1983, Dr. Clark worked for the consulting firm of Anderson-Nichols in the area of coastal processes, particularly shoreline erosion and wave damage and wave runup and damage risk analyses.

Connecticut Coastline Studies: Wind-Wave Characteristics in Long Island Sound

By: Dr. W. Frank Bohlen, Marine Sciences Department,
University of Connecticut

The Connecticut coastline consists of a complex of geological structures including embayments and small estuaries, bedrock or till headlands, and barrier spits and beaches. The stability of these structures varies as a function of their composition, their elevation relative to mean sea level, and the energy levels of incident wind waves and local tidal currents. The combination, presently characterized by progressive sea-level advance, favors erosion of varying magnitudes resulting in the loss of shorefront lands and sedimentation and infilling of navigable waterways.

Surveys by the U. S. Army Corps of Engineers and the Connecticut Department of Environmental Protection indicate that severe erosion affects approximately 17 percent of the coastline. Most occurs along beachfronts resulting in an average retreat of 1.0 to 1.5 ft/yr. Sedimentation affects all harbors requiring the annual dredging of approximately 10^6 yd^3 of material to maintain navigability. Annual costs associated with erosion/sedimentation damage and/or control is in excess of $10 million.

Despite these costs and associated impacts, many of the processes governing erosion and sedimentation within Long Island Sound are poorly understood. In particular, quantitative data describing (1) the amplitude response characteristics of the surface wave field under a variety of wind conditions including aperiodic storms and (2) sediment transport routes and their effect on beach erosion and harbor sedimentation are required.

To acquire these data, field investigation sponsored by the State of Connecticut CAM Program was initiated in November 1981. Bottom-mounted pressure-transducer wave gages were established at two locations, one within the western sound adjacent to Penfield Reef and the other in the eastern sound south of Six Mile Reef. At each location, data were obtained at a sampling rate of one burst per hour over a one-year sampling period. Concurrent wind data were obtained from proximate shore stations. These data have been compiled in atlas format to provide the first series of comprehensive wave data available for the sound.

In addition to this data compilation, analyses using the data to verify available fetch-limited wave generation models, to supplement concurrent directional measurements made close inshore at selected sites, and to complement shoreline response studies at beaches in Fairfield and Old Saybrook, Connecticut, have been initiated.

The combination of these data complement a variety of coastal management schemes and point to the continuing need for detailed wave studies of several types if efficient engineering design is to be realized at minimal project cost.

Dr. W. Frank Bohlen is an Associate Professor of Physical Oceanography in the Marine Sciences Department of the University of Connecticut. He holds a Ph. D. in Physical Oceanography from MIT/Woods Hole Oceanographic Institute and a B.S. in Electrical Engineering from the University of Notre Dame. His research efforts focus primarily on various aspects of the dynamics governing sediment transport in coastal waters. Most recently, he has been involved in a series of field investigations designed to evaluate the effects of storms on sediment stability in dredged material disposal sites in Long Island Sound. He serves as associate editor of Estuaries and is a member of the National Academy of Science/National Research Council Committee on National Dredging Issues.

Massachusetts Coastal Area

By: Dr. Duncan Fitzgerald, Boston University

The Massachusetts coastal area has been most drastically affected by glacial history. Not only have glaciers caused a great deal of excavation, but they have dumped sediment in the coastal zone. This sediment has been redistributed by tide and wave processes.

Buzzards Bay Area

The soil in this area consists of moraine and outwash plain. These deposits are very rich and wide and provide a great deal of sand resource for barrier island construction. Eastward, this region is covered by a thin veneer of till; its sediment is poor in sand. Buzzards Bay has mostly an incised coast caused by glacial excavation of the shoreline as well as by excavation effected by streams of melted water as the glaciers retreated. Westward, the coast consists of a number of linear north-/south-trending rock ridges separated by incised bays. The mouths of the bays are fronted by gravel and sand spits which continue to migrate landward, decreasing the volume of water in the bays. The tidal prism is not great enough in these embayments to keep a tidal inlet open. This is a tide-dominated area.

Cape Cod Region

Cape Cod consists entirely of glacial sediments. There is a great deal of sand available to build various coastal morphologies. Spits have formed. As the spits have moved landward due to washovers and the building of tidal deltas, the embayment areas have decreased such that most of the ponds are kept open only by constant dredging. These areas are important commercially since they support considerable populations of shellfish.

Nantucket Sound

The major winds to affect this area come from the southwest. These winds are primarily associated with two different climatic events. One is a low-pressure system that swings up through the Great Lakes region, and its counterclockwise circulation generates southwesterly winds. The other climatic condition comes when air between the ocean and land mass is warmed by the sun, rises, and produces a cool sea breeze providing choppy waves. This area is wave-dominated.

Westport River Inlet

Navigation out of the inlet is a problem. There is a lot of sand in the back area environment and a very shallow ebb-tidal delta. A large fishing fleet uses this harbor. This area is very shallow. During a storm the bows of some boats dip and touch bottom. Dredging has brought little success. Jetty construction and creation of two channel locations for different size vessels have been recommended.

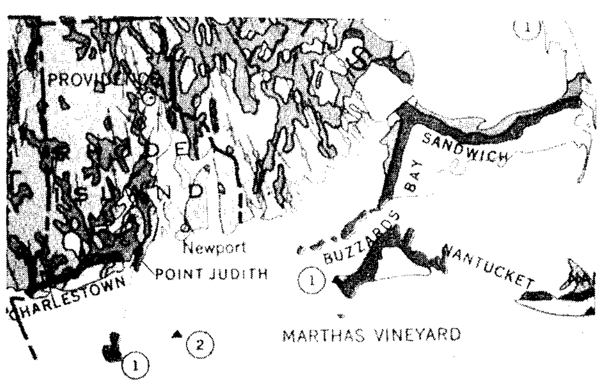
Slocum River Inlet

There is a very large swash platform in front of this tidal inlet. Bedrock outcrops and submerged boulders make this channel difficult to navigate.

Bass River Inlet

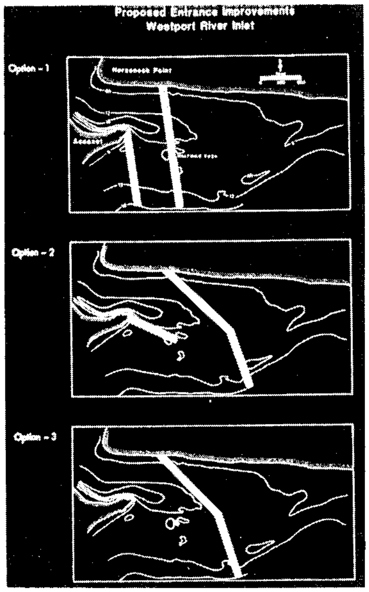
How much sand is being transported into this inlet is an unresolved question; no good equations exist that can be used to resolve it. Not only are tidal currents depositing sand at the end of the spit, but sand is washing over the spit during a storm, both of which processes contribute to a smaller bay area.

Dr. Duncan Fitzgerald received a B.S. degree in 1970 from the University of New Hampshire, an M.S. in Geological Oceanography in 1972 from Texas A&M University, and a Ph.D. in 1977 in Geology from the University of South Carolina. He is Chairman of the Geology Department and Associate Professor of Geology in the Coastal Research Department at Boston University, specializing in geomorphology and coastal processes. Currently, Dr. Fitzgerald is studying tidal inlets in southern Maine under the Sea Grant Program of the National Oceanic and Atmospheric Administration.



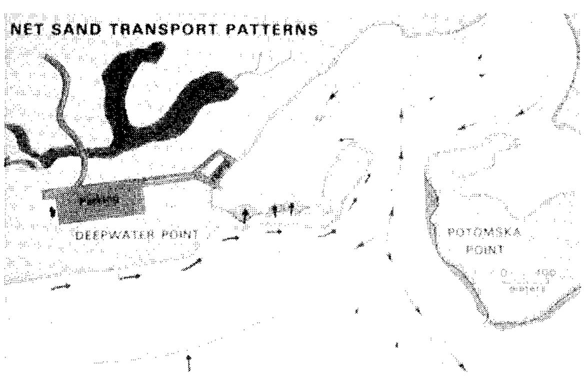
Buzzards Bay

Cape Cod



Proposed jetty con-
struction at Westport
River Inlet

Slocum River swash platform



Slocum River Inlet sediment
transport patterns

Bass River Inlet

Maine Coastal Area

By: Dr. Kenneth Fink, University of Maine

Along the shoreline of Maine are rockbound areas and beaches. These beaches exist because of the very indented shoreline, with sediment supplied by wave reworking of glacial sediments. The thirty miles of beaches along the southwestern portion of the State are economically valuable to its towns and metropolitan areas. Our conflicting interests here are development, preservation, and recreation. Summer cottages have become year-round homes. Normal, natural shoreline recession affects not only houses but the structures designed to protect them.

The Maine coastline has a swash align system. Studies show there is a significant relationship between orientation of the beaches and the offshore contour. The dominant wave refraction pattern controls the orientation of the shorelines.

The various forms of beaches are (1) small areas without tidal inlets, (2) straight beaches with small barrier spits extending from rocky headlands, (3) barrier tombolos, and (4) cuspate beaches with foreland.

Alongshore transport of sand is not an important phenomenon along the coast of Maine. The sand is not being lost, but recycled.

Historically, Maine has a sea level rise rate of about 3-1/2- to 4-fold. The shorelines are receding more as events are triggered by northeast storms. The wind directions, sand texture, slope permeability, and rate process have been studied. Vegetation/shoreline relationship is changed by the shoreline meandering process; change has occurred on a biannual to annual basis. The information of the role of plants in Maine beach processes will be produced as a technical publication and a layman's guide.

Dr. Kenneth Fink has been Associate Professor of Geological Sciences and Oceanography at the University of Maine at Orono since 1969 and is currently investigating the morphodynamics of tidal inlet shorelines along the coast of Maine. He received his Ph.D. in Geology and Geophysics from the University of Miami Institute of Marine Science and is a member of the Geological Society of America and the American Geophysical Union.

Waves in the Gulf of Maine

By: Dr. B. R. Pearce, University of Maine

Design Waves

Extreme wave statistics for the Gulf of Maine are calculated using a sequence of numerical techniques. A model which calculates synoptic wind velocities for "northeasters" or extratropical storms and numerical wave hindcast models are discussed, and a parametric-type wave model is used for the simulation. A 32-year record of synoptic pressure charts is examined, and the 22 strongest storms are chosen for analysis. Each storm is used for a hindcast simulation. The highest wave height for each storm for each grid element is obtained. That set is then used to generate the extreme statistics at each point in the model grid. The significant wave heights in the Gulf of Maine were as high as 13 meters.

A Model for the Development of Wave Spectra in Bays

A technique is presented for modeling the evolution of wave spectra in bays. In particular, the author is concerned with those bodies of water where bathymetric effects are important and where conventional methods such as ray tracing may not always work. For example, wave orthogonals refracting around an island or submerged feature are susceptible to intersection or inordinate divergence, yielding a meaningless solution beyond that region.

The technique is based upon a modification form of the Helmholtz equation, thus incorporating refraction and diffraction. In order to allow a computationally feasible solution, a splitting technique following Radder or Dalrymple et al. is used which transforms the elliptic Helmholtz equation into a parabolic form which can be solved conveniently. Figure 1 below shows a schematic diagram for Ito and Tanimoto's hydraulic model test of waves over a circular shoal. Figures 2 and 3 show results from the parabolic model compared to hydraulic model results for the longitudinal and transverse sections, respectively.

Dr. Pearce is Associate Professor of Civil Engineering at the University of Maine at Orono. He holds a B.S. in Physics and a Master's in Ocean Engineering from Massachusetts Institute of Technology, has done graduate study in the Department of Geology at Harvard University, and holds a Ph. D. from the University of Florida's Department of Civil and Coastal Engineering. He is a member of the American Society of Civil Engineers, the International Association of Hydraulic Research, and the American Geophysical Union.

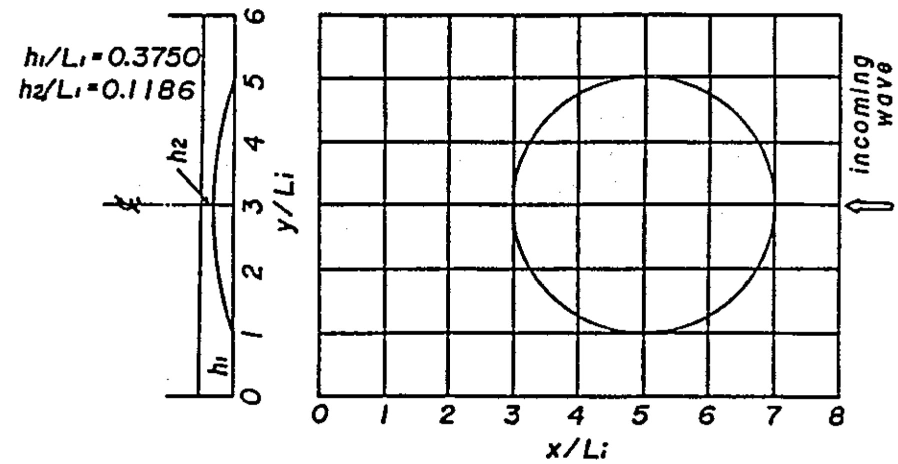


Figure 1

H = Wave Height
H_i = Incident Wave Height
L_i = Incident Wave Length
h_1, h_2 = Water Depth
______ = Parabolic Model
oooo = Ito and Tanimoto Data

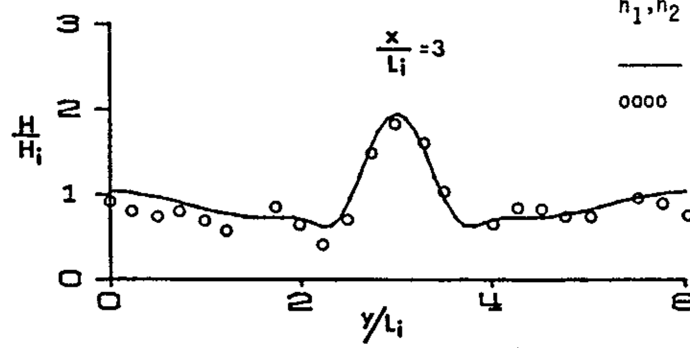


Figure 2

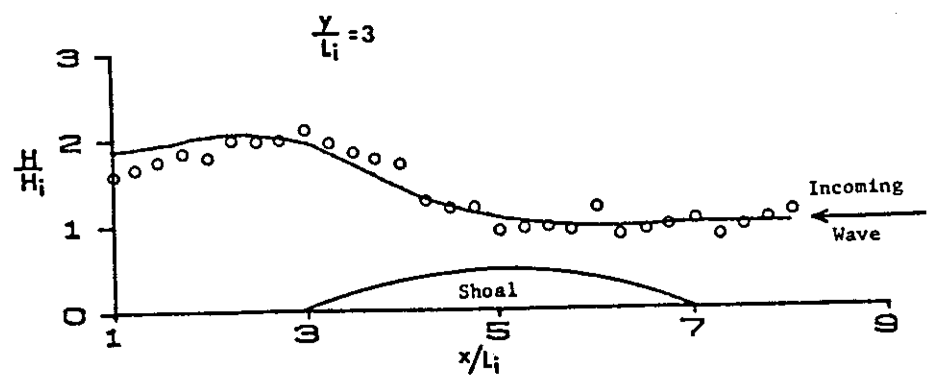


Figure 3

Interfacing Remotely Sensed Observations and Coastal Process Models

By: Dr. Peter Cornillon, University of Rhode Island

A group of professionals from the Department of Ocean Engineering and the Graduate School of Oceanography at the University of Rhode Island and at Applied Science Associates, a private company in Wakefield, Rhode Island, have, over the past several years, developed numerical models addressing coastal phenomena. In this presentation attention was focused on tidal circulation and wave refraction models as applied to the Gulf of Maine region and to coastal waters off southern New England.

Model outputs have been integrated with satellite-derived thermal infrared images of the region on a sophisticated image display device to show the potential for evaluating these results with a dynamic display. In addition, this form of display underlines the value of satellite-derived sea surface temperature fields both as input and as a form of verification for the circulation models. The models are at present well developed, as are many of the techniques for analyzing the satellite data. The integration of the two is just now beginning.

Dr. Peter Cornillon is a research faculty member in satellite oceanography at the University of Rhode Island, where he holds joint appointments at the Graduate School of Oceanography and the Department of Ocean Engineering. He received both a B.S. in Engineering Physics and a Ph.D. in Experimental High-Energy Crisis and Physical Oceanography from Cornell University. From 1972 to 1975, Dr. Cornillon worked for the General Motors Research Corporation. He was a visiting member of the Department of Meteorology and Physical Oceanography at the Massachusetts Institute of Technology from 1979 to 1980.

PART V: COASTAL ENGINEERING RESEARCH BOARD COMMENTS

Summaries of the comments of the three military Board members in attendance are given below.

BG C. E. Edgar III

New England Division has done an outstanding job on the three projects to which we made field visits, especially at Cape Cod Canal where the new radar control has kept up with the state of the art.

Specific matters for NED's consideration are (a) determining Federal-versus-private owner interests along the Cliff Walk, Rhode Island, project as the Corps considers future maintenance and (b) how sea level rise will affect operation of the New Bedford Hurricane Barrier gates.

General considerations for the Corps are as follows:

a. That we make efforts to take advantage of advanced technology in our endeavors.

b. That we better define Federal interest in supporting shoreline and floodplain development: how much responsibility for refinancing shoreline construction resides with the Federal Government and how much with local governments?

In addition, the difficulty Corps field activities have in obtaining adequate research instrumentation suggests that its Research and Development community (i.e., WES and the other Corps Laboratories) provide instrumentation on loan to Districts and Divisions in need.

BG James van Loben Sels

The Corps should stay sensitive to Federal-versus-private interests, as we do our work along Cliff Walk, and consider opportunities for contributions of both. We should continue to preserve as best we can its natural aesthetic values.

BG Thomas A. Sands

The New Bedford Hurricane Barrier is an interesting project which would be very difficult to get under way today in light of environmental restrictions. It would be useful to discover what kinds of marine organisms were present before construction of the barrier and what impact the structure has had on their populations over the past 16 years.

Comments of the three civilian Board members, Prof. Robert L. Wiegel, Mr. Willard Bascom, and Prof. Bernard LeMéhauté, are summarized in their letters (and in the comments of Prof. Wiegel, abstracted from the meeting's transcript), which follow.

UNIVERSITY OF CALIFORNIA, BERKELEY

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HYDRAULIC AND COASTAL ENGINEERING

2 November 1983

B. General C.E. Edgar, III, President
Coastal Engineering Research Board
Deputy Director of Civil Works
(DAEN-CWZ-A), Room 7231
Dept. of the Army Corps of Engineers
Washington, D.C. 20314

Dear Ernie:

This is in response to your request for comments in the Coastal Engineering Research Board, and CERC. I will not repeat the comments I made at the 40th CERB meeting, as these are in the record. Rather, I would like to make three specific suggestions that have to do with coastal engineering research and with CERB meetings.

In regard to ARSLOE, the joint effort of many individuals and institutions that was conceived by, and coordinated by CERC personnel. The field measurements were made at the FRF, Duck, NC during the fall of 1980. This was an imaginative and successful experiment, but its value will be lost if the results are not published. Some of the work has been published already; perhaps other work is published, and I am just not aware of it. I think an overall status report by CERC would be very useful.

Field research is expensive, time consuming, and often difficult to perform. It is not easy for most universities to do this type of research with graduate students, so they concentrate on laboratory and theoretical studies. The most important research in the next decade should, in my opinion, be conducted in the field. CERC could be the leader in this in the USA. I recommend that a ten-year research program be developed by CERC staff for consideration by CERB.

I think the idea of holding CERB meetings at different coastal sites is an excellent one. It affords an opportunity for personal interaction between district personnel and a continuing opportunity to obtain first hand knowledge of the coastal problems that district personnel must solve. I hope that this aspect of CERB meetings will continue.

Sincerely yours,

Bob

Robert L. Wiegel
Professor of Civil Engineering

cc: Colonel T.C. Creel
Willard N. Bascom
Bernard Le Mehaute

RLW/SVS

DEPARTMENT OF CIVIL ENGINEERING • 412 O'BRIEN HALL • UNIVERSITY OF CALIFORNIA • BERKELEY, CALIFORNIA 94720

Richard A. Denton 415/642-9028
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J. W. Johnson 415/642-7341
David K. Todd 415/642-7341
Catharine van Ingen 415/642-6998
Robert L. Wiegel 415/642-7340

Comments made by Prof. Wiegel at the meeting were as follows:

a. We are working on the problem of the nonlinearity of waves in shallow water.

b. The EPA study on sea level rise is flawed because it does not take coastal subsidence into account. The National Research Council is trying to get a major engineering study going--the Corps is providing some funds--to investigate this complicated problem.

c. Not enough is known about the uplift and horizontal forces at work on coastal structures.

d. The 19th ASCE International Conference on Coastal Engineering, to be held in Houston, Texas, on 1 September 1984, will include a special workshop devoted to the problems of coastal engineers from local areas. (Prof. Wiegel is Chairman of the ASCE Coastal Engineering Research Council.)

coastal water research

Southern California Coastal Water Research Project
646 West Pacific Coast Highway • Long Beach, California 90806 • 213/435-7071

October 25, 1983

B Gen. Charles E. Edgar, III.
Depty Director of Civil Works
(DAEN-CWZ-A)
Room 7231
Washington, D.C. 20314

Dear Gen. Edgar:

The meeting at Falmouth went very well; I believe the whole group learned from both the talks and visits. I look forward to the next one in Seattle.

In accordance with your wishes I will repeat the high points of my final remarks so you will have my views in short, written form. They are in reverse order of priority with the most important, longer-range, items last.

1. I encourage the Corps to pay increasing attention to the following matters about which we heard presentations.
   A. Remote sensing. Although I have doubts that lasers will do all the magic things claimed by Ed Link much better things are coming and the Corps must have a few fully briefed professionals who are prepared to lobby with NASA or NOAA for what it wants. In a decade there will be real-time data from scatterometers, altimeters and SARs on satellites. Then the Corps will have wave data and sealevel information beyond its wildest dreams.
   B. Polar research as indicated by Breslau. Especially new islands in the Arctic, under-ice pipelines and better knowlege of permafrost. These will surely be important!
   C. More use of cheap, convenient, TV recording of shoreline conditions, large storms, ice phenomena, etc. You get instant replay, low light level, color, 30 minute tapes, and almost foolproof (my own outfit is JVC: SR4 Total cost $2,000).

2. Toxicity of dredge material. If the Corps and EPA have agreed to abide by the results of the ongoing "verification" tests, you should be certain that they come out to a scientifically acceptable answer. I fear that they may not for the reason that the definitions used seems to me to be fuzzy; the detailed objectives are not well formulated; and the studies EPA apparently wants to do are like their "monitoring" programs in which they expensively measure too much of the wrong things.

If indeed, the question to be answered is the toxicity of dredge spoils, then the corps must see that toxicity is measured directly. This means chemical analysis of contaminants in animals tissues by molecular-weight fractions, enzyme analysis, histopathology, and reproductive capacity. The answers cannot be found by a measuring bioaccumulation in polychaetes and mussels or by comparing benthic community structures.

Please be warned, the wrong outcome will hurt all concerned and cost our country billions of dollars.

3. Study the effects on Corps works of large sealevel changes -- for example, one cm/year until the year 2033 (fifty years away). In one working life time much of the existing shoreline could be greatly changed. Many barrier beaches would be unusable; large coastal cities would need protection; pier decks would be too low. Harbors might require less dredging; the Mississippi delta will be in trouble; the Bay of Fundy will change; etc. Such knowledge could be important in shaping policy for the long run.

4. The Corps should make a study leading to a position paper on the subject of how long or how many times a piece of coastal property should be defended. (Considering the diminishing supply of sand, the increase in sea level, the fact that ((in some places)) erosion seems to be dominant and several sets of sea defences have failed.) Perhaps a new formula for cost/benefit analysis that considers cost over several periods of reconstruction would come out of it. Or possibly a set of criteria under which the residents would carry insurance to reimburse the Corps. Or maybe new rules about when to buy property under eminent domain and reconvert it to public beach.

5. <u>Moving sand</u> -- especially at entrances, from harbors or for replenishing beaches. The Corps seems to have relinquished its responsiblity for efficiency by allowing contractors to bid with any kind of dredge that is handy-- because there is little thoughtful design work on the kinds of dredges that are needed.

I do <u>not</u> propose that the Corps design and build dredges but that it make studies of how to improve pumps, cutterheads, pipes and pipe connections, dewatering equipment, surf platforms, etc. Many of these have long been ripe for development and I am sure that better components can be assembled that will reduce the cost of moving sand. Components could be tested, benefits shown and results made available.

That kind of know how, along with continuing contracts for a proper dredge could cut costs one-third to one-half.

Such research would meet the needs of the Corps better than improving wave height forecasting reliability by a foot or two.

I hope some of the above is helpful and may I repeat my view that the purpose of research is to provide options for management by giving early warning of the possibilities ahead.

With kindest regards.

Sincerely,

Willard Bascom

Willard Bascom

WB:sm

University of Miami
Miami, Florida 33149

DIVISION OF OCEAN ENGINEERING
Dorothy H. and Lewis Rosenstiel
School of Marine and Atmospheric Science
4600 Rickenbacker Causeway (305)

27 October 1983

Tilford C. Creel
Colonel, Corps of Engineers
Waterways Experimental Station
P. O. Box 631
Vicksburg, Miss 39180

Dear Sir:

I very much appreciated the opportunity to visit the New England coastline for as much its beauty as for our professional interest. The presentations by the Corps personnel, the representatives of academia and local agencies, and the field trip (and my own personal travel before the meeting) have all permitted me to assess the problems of the region, relevant to coastal engineering research.

Considering the relative morphologic and oceanic complexity of the region, I fully realize the difficulties encountered by the district engineers, if equipped with the SPM manual only. Coastal engineering solutions cannot be mass produced and are difficult to summarize in a handbook. New Englanders of the Corps need a good training in the field of coastal engineering in addition to their knowledge of the region. Maybe more than others who live on a less complex coastline - which does not imply less problem prone - do they need a close contact with CERC. It also stresses the importance of good CERC documents to help the districts.

The first research gap is the poor state of the art in determining wave climatology and wave design criteria in shallow embayment. This includes transformation from deep to shallow water, depth and fetch limited wave generation by wind, shallow water spectrum, and wave current interaction. This deals with methodology.

It appears that even in deep water, there is little information on long term wave statistics except for the work done at CERC based on hindcasting. For lack of an appropriate national program, a local wave measurement program will be useful.

The second point which I would like to make, even though I may be overly insistent, but which has clearly appeared from the meeting, is that the Corps should heavily tap outside resources to solve their local problems. From the samples of presentation given by outsiders, it became evident that the capability exists and they are anxious to be used. Considering the broad recognition of the leading New England institutions, it would be a mistake not to depend upon them.

The third point which has bothered me a lot for a long time is the relative lack of influence of engineers on many issues for which we have an insight not attained by other more influential professions - such as the lawyer. One of these issues is coastal zone management. The slide presentation reinforced my feeling.

The fact that the flood insurance program does not balance its budget encourages construction where there should not be. But there little which we can do about it.

By opposition, I believe that more can be done about arousing the public awareness and to influence local authority. The Corps has made tremendous progress in this direction with brochures such as "help ourselves" and the like. But it is evidently not sufficient in view of the results.

The use of taxpayers money to educate the public on a problem of magnitude created by shoreline erosion, storm surge, etc., is appropriate, but I see no reason as taxpayer, to pay for a front beach property owner in case his property disappears.

This implies a wider distribution of existing documents, films, even an advertizing campaign.

The concept of the setback line such as defined in Florida (not always such as applied to Florida coastline) should be generalized. The development of Kiowah Island (S.C.) should be given as an example of good development in harmony with natural beach processes.

All these seem too much for the Corps, budget-wise, but I repeat and concur with B. Bascom that money can be saved on dreging cost with an appropriate program of research.

Sincerely,

B Mehaute

Bernard Le Mehaute

/m

PART VI: RESPONSE TO COMMENTS AND RESEARCH NEEDS

By: Dr. Robert W. Whalin, Chief, CERC

CERB Members' Comments

The Corps should do the following: (1) take advantage of advanced technology; (2) better define Federal interest in supporting shoreline and floodplain development; (3) ensure that its research and development community provide instrumentation on loan to Districts and Divisions in need--BG C. E. Edgar III.

CERC has placed increased emphasis on the use of advanced technology in all of our endeavors. Our new directional spectral wave generators are the first in the United States and among the most advanced in the world. Advanced data collection techniques such as the Coastal Ocean Dynamics Radar and laser bathymetry are being investigated, and we are discussing with OCE the initiation of a new research work unit to advance instrumentation technology for measurements in the surf and nearshore zones. CERC numerical modeling efforts are taking advantage of the most significant current research to provide a set of two- and three-dimensional models for routine use and for investigating the most sophisticated aspects of nearshore hydrodynamics and coastal sediment transport. Adaptation of advanced technology will continue to be given priority in our efforts to provide the coastal engineering community with more cost-effective and competent techniques and services.

We acknowledge the important role that the Corps can play in defining the limits of shoreline and floodplain development. This important policy question will be discussed with the appropriate OCE personnel; the most effective use of CERC capabilities to fulfill Corps missions and responsibilities will be examined, and the relevant technology transferred to appropriate agencies and organizations.

The research community shares the difficulty experienced by Corps field offices in acquiring adequate instrumentation. Those instrumentation resources available are specialized devices that were procured to fulfill specific research and field office project support needs. Because these devices are generally used on several projects at once and are already overcommitted, CERC can lend such equipment only on an "as available" basis. We will make every effort to fulfill field office data collection requirements by scheduling the necessary manpower and equipment within existing program constraints.

It is important to consider the natural aesthetics of an area when undertaking Corps projects--BG James van Loben Sels.

CERC works very closely with the Environmental Laboratory of WES and with Corps Districts and Divisions to maximize the environmental compatability of our coastal projects.

A study to discover what effect the New Bedford Hurricane Barrier has had on the marine environment would be useful--BG Thomas A. Sands.

An investigation of the effects of the New Bedford Hurricane Barrier on marine organisms would be a very interesting and meaningful environmental study. If NED can fund such an effort, it could provide a unique data set for determining the impact of such structures on New England waters. While a survey of existing marine organisms can be readily accomplished, the availability of adequate preconstruction data will determine the accuracy of the results of such a study, hence its usefulness for future coastal projects.

CERC ought to do the following: (1) publish results of the 1980 ARSLOE experiment; (2) develop a ten-year research program, with strong emphasis on field research; (3) study the relatively unknown uplift and horizontal forces at work on coastal structures. The National Research Council wants to investigate sea level rise and correct the flaws in the EPA study. Holding CERB meetings in different coastal Districts is an excellent idea because it provides the Board firsthand knowledge of particular coastal problems; the next ASCE International Conference on Coastal Engineering will devote a workshop to local problems--Robert L. Wiegel.

We concur with the importance of the Atlantic Remote Sensing Land-Ocean Experiment (ARSLOE) study. CERC will provide a status report on ARSLOE and resulting publications at the next CERB meeting. To date, over 50 technical papers have been published and eight informal reports prepared. The latest informal report, "Summarization of Instrumentation and Logistics," to be published by the National Oceanic and Atmospheric Administration, provides a list of most of these publications. A special issue of the IEEE Journal of Ocean Engineering (October 1983) was devoted soley to the results of ARSLOE, as was a special session of the Oceans' 82 conference. We will evaluate the feasibility of publishing a comprehensive report on the experiment during FY 84.

We concur with Professor Wiegel's comments concerning the importance of field research in the next decade. While we currently develop and review a five-year research plan on an annual basis, a ten-year plan would be most beneficial for identifying major new thrusts, scheduling synergistic research efforts, and integrating emerging technology into ongoing research programs. In addition, the ten-year time frame would be appropriate for identifying research needs created by major anticipated changes in Government policy and emerging national problems. We will initiate long-term planning during FY 84 in cooperation with our OCE monitors and will discuss the results with the civilian members of the CERB and other selected consultants to develop a viable instrument for focusing CERC resources in the future.

Professor Wiegel's suggestions concerning the study of the relatively unknown uplift and horizontal forces that affect coastal structures has been forwarded to the OCE technical monitor for the Coastal Structures Evaluation and Design Program. A summary of current knowledge on these phenomena will be prepared and potential programs to address them discussed at the next research program review.

The CERC work unit, Barrier Island Sedimentation Studies, is contributing to the study of sea level rise in several ways. First, funds are being provided to the Marine Board, National Research Council, to support their sea level rise research investigations. Second, Dr. S. Kimball May, Principal Investigator for the CERC work unit, has been appointed as the CERC liaison representative to the Marine Board for sea level rise studies. Finally, in-house CERC research efforts will provide valuable complementary information on barrier island formation and evolution. We remain committed to the success of sea level rise research and will continue to focus substantial resources into this area.

We intend to continue holding CERB meetings at different coastal sites around the country. We concur that the interaction of Board members with local District personnel (1) provides the members first-hand knowledge of the coastal engineering problems that the Districts must solve and (2) enables District personnel to gain the unique perspectives of Board members.

CERC will take full advantage of the proximity of the Houston ASCE meeting to participate as much as possible. A postconference tour of WES planned for conference attendees will provide them an opportunity to view the CERC facilities at WES.

<u>The Corps should make increasing use of remote sensing for data gathering and for TV recording of coastal phenomena. More polar research should be undertaken, as well as investigations of (1) effects of sea level changes on Corps works and (2) standards for defense of coastal property subject to pervasive sea attack. Objectives for Corps-EPA measurement of dredged material toxicity should be clear, and toxicity should be measured directly. Most important, the Corps can save money by improving the efficiency of its sand-moving dredges--Willard Bascom.</u>

We appreciate Mr. Bascom's comments concerning the importance of remote sensing in the coming decade. The use of remote sensing techniques for coastal data acquisition is receiving increased emphasis at CERC. The Coastal Ocean Dynamics Radar will provide current measurements out to 60 km from shore and directional wave-height spectra out to 20 km from shore. Cooperative efforts are underway with the Naval Research and Development Activity and NASA to evaluate advanced airborne laser systems for bathymetric mapping, and an interactive digital image processing system is being acquired to allow exploitation of optical, thermal, and radar spacecraft imagery. Final plans are being made to conduct a large-scale remote sensing demonstration program to establish the operational capability of available remote sensing techniques for coastal data collection.

The U. S. Army Engineer Cold Regions Research and Engineering Laboratory has the responsibility for our ice-related research and development in the Arctic and is addressing these problems. The appropriate OCE technical monitors have been notified of the recommendation for enhanced arctic coastal research.

The impact of potential large sea level changes cannot be underestimated. Through our in-house research and co-sponsorship of the Marine Board study on

The Engineering Implications of Sea Level Rise, we are working at the forefront of research and development in this area. CERC has the necessary facilities and expertise to make projections of impacts on specific Corps structures and individual coastal regions of the U. S., given the tasking and resources to do so.

The extent and frequency of Federal protection of coastal properties are very important and complex issues. Since these considerations are under the purview of the policy and planning offices of the Corps of Engineers, we will pass this suggestion on to the appropriate office in the Civil Works Directorate, OCE. CERC can provide assistance in addressing the technical aspects of these issues.

Mr. Bascom's comments concerning Corps-EPA measurement of dredged material toxicity are appreciated and have been forwarded to the Director of the Corps Environmental Effects of Dredging Programs for consideration.

The development of improved sand dredging efficiency is enticing and has considerable merit. CERC will pursue this idea with the Water Resources Support Center, which has responsibility for the dredging operations of the Corps of Engineers. An innovative research program in this area could reap considerable economic benefits for both the Corps and the taxpayer.

Because of their region's complex coastline, New England Division's coastal engineers need close contact with and careful training by CERC, especially for wave prediction in shallow embayments and deepwater wave forecasting. In addition, the Corps should here especially tap outside resources to solve local problems. Engineer influence on coastal zone management should increase: the Corps must make the public aware of how much the flood insurance program costs the taxpayer. Money saved through more efficient dredging operations will allow the Corps to reach more of these goals--Bernard LeMehaute.

CERC is working with NED to establish recurring regional workshops to address coastal problems of specific importance to NED. The workshops will be one of numerous mechanisms to fine-tune general coastal engineering techniques to New England coastal needs.

The First Coastal Engineering Hydraulic Design Conference held in Jacksonville, Florida, in October 1983 brought District, Division, OCE, and Laboratory personnel together to discuss current problem areas and new technology developments in coastal engineering. The conference provided a forum for focusing laboratory resources on critical problems faced by the field offices.

A local wave measurement program to supplement the lack of long-term wave statistics in shallow embayments is critically needed for the New England area. Such an effort would properly be a part of the Coastal Data Collection Program managed by CERC. Funds are not currently available to expand this program; however, we are currently working with OCE to increase funding for critically needed index wave gages for areas such as New England.

Decreases in funding over the past several years have reduced our ability to fully utilize outside sources. This funding decrease, coupled with inflation, has produced a current Coastal Engineering R&D program supported at less than two-thirds the funding level of several years ago. We hope this trend has stopped and that CERC can become more diverse and flexible by increasing its use of the academic and private sectors.

Dr. LeMehaute's comments on the Flood Insurance Program and public awareness of coastal flooding raise important and complex policy issues. CERC can provide the technical expertise to project the consequences of storms and coastal flooding, and we will strive to create more public awareness at every opportunity. We agree that there is no easy remedy to this problem.

New England Division Research Needs*

NED's most urgent need is for New England area wave data, especially in shallow embayments and bays. Also needed are (1) a standard northeaster tide or storm surge program for use in NED hurricane surge models, (2) guidance on repair of coastal structures, and (3) verification of programs and models, developed under other coastal conditions, for the New England coastline. How can NED, with its lack of data and funding, solve the diverse coastal engineering problems of its complex coastline?--Lawrence A. Blake.

We concur with NED that their highest priority need is for wave data in the New England area, especially in shallow embayments and bays where complex bathymetry makes prediction of wave statistics extremely difficult. We are working with NED and OCE to obtain the necessary resources to meet these requirements. Every effort will be made to expand the Coastal Data Collection Program and wave gaging efforts in New England to provide the basic data urgently needed by NED. Similar needs occur along other stretches of the east coast and in the Gulf of Mexico.

The need for a standard northeaster tide or storm surge program for hurricane surge prediction is common to the entire Atlantic coastline from Cape Hatteras to Maine. CERC and OCE are identifying the resources to develop an overall coastal water level prediction system which will produce programs that (1) address the specific needs of NED and others and (2) standardize as much as possible the techniques used for coastal water level predictions.

The requirement for safe and economical rehabilitation or repair of coastal structures is of paramount importance for rebuilding our infrastructure. We anticipate that the coastal engineering task area of the Repair, Evaluation, Maintenance, and Rehabilitation (REMR) program will provide the basic technology and methodologies to meet these needs. CERC will work closely with Corps field offices in the development and application of the products emerging from the REMR program.

CERC shares NED's concern for verification of the applicablity of

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* The transcript of Lawrence A. Blake's presentation of NED research needs, as well as CERB and OCE questions and comments, is provided in Appendix A.

analytical techniques to the complex coastal environment of New England, and we attempt to quantify areas of applicability of our new R&D products as they are produced. Questions concerning their applicability to a specific problem or site condition often can be addressed through the one-stop R&D services program. CERC is currently developing a number of procedures that address some of the extremely complex problems presented by shallow bathymetry in protected and semi-protected embayments. Verification of these procedures continues with the initial project applications. For example, a wave refraction-diffraction code has been developed that will be published and distributed in FY 84; this program could be effectively used by NED. A shallow-water wave model recently developed by CERC has been applied with the assistance of prototype data to project studies in Saginaw Bay, Michigan, Mississippi Sound in the Gulf of Mexico, and Atchafalaya Bay, Louisiana. With each application, the requirement for prototype data for verification is reduced. This is a very effective approach for addressing complex problems with the most advanced techniques available. CERC will work closely with NED and other field offices to provide such assistance on a cooperative basis.

By isolating specific critical problem areas, CERC, OCE, and appropriate Division and District offices can work together to marshal the resources required to improve the Corps' design and construction capability. The complexity of many coastal phenomena demands sophisticated solutions that we can best develop together. While there are no simple solutions to many of these problems, our persistent, intelligent efforts will yield useful answers.

APPENDIX A: TEXT OF SELECTED PRESENTATIONS

This appendix contains full texts of the following speeches:

- a. Streamlining of NOAA Contract Procedures, by James W. Winchester.
- b. CRREL's Cold Regions Coastal Engineering Research Program, by Dr. Lloyd R. Breslau.
- c. NED Research Needs, by Lawrence A. Blake.
- d. New Bedford Hurricane Barrier, by Joseph L. Ignazio.

STREAMLINING OF NOAA CONTRACT PROCEDURES

An Address by

Associate Administrator James W. Winchester

before the

40th Meeting of the Coastal Engineering Research Board

North Falmouth, Massachusetts

October 18, 1983

THE FEDERAL GOVERNMENT, LIKE ALL CORPORATIONS AND ORGANIZATIONS, CANNOT FUNCTION WITHOUT CONTRACTING WITH OUTSIDE CONSULTANTS, SUPPLIERS AND VENDORS FOR SOME PRODUCTS AND SERVICES. IN SPITE OF THAT DEPENDENCE UPON CONTRACTING, MOST FEDERAL AGENCIES DO NOT HAVE EFFICIENT AND WELL MANAGED CONTRACTING PROCEDURES. THE RESULTS ARE WASTE OF TAXPAYERS DOLLARS, UNNECESSARY CONFRONTATIONS BETWEEN GOVERNMENT AND INDUSTRY, AND OPPOSITION OF FEDERAL EMPLOYEES TO CONTRACTING FOR GOODS AND SERVICES. THEREFORE, IT IS INCUMBENT UPON SENIOR FEDERAL MANAGERS TO DEVELOP AND MAINTAIN AN EFFICIENT CONTRACTING ORGANIZATION WITHIN THEIR AGENCIES SO THAT THE FEDERAL GOVERNMENT CAN PROCURE THE NEEDED GOODS AND SERVICES EXPEDITIOUSLY AT MINIMUM COSTS.

NOAA HAS BEEN NO EXCEPTION TO POOR CONTRACTING PERFORMANCE. UNTIL RECENTLY, IT WAS NOT UNUSUAL FOR THE TIME INTERVAL BETWEEN INITIATING A REQUEST FOR PROPOSALS (RFP) AND THE AWARD OF A CONTRACT TO BE AS MUCH AS ONE YEAR. THERE ARE ALSO MANY INSTANCES OF COST OVERRUNS, POOR PRODUCTS, AND DEFAULTS BECAUSE THE AWARD WAS MADE TO A COMPANY THAT WAS NOT QUALIFIED TO PERFORM THE WORK. AS A GENERAL PRACTICE, THE PROCUREMENT STAFF WAS NOT LOCATED NEAR THE PROGRAM MANAGEMENT STAFF, AND THERE WERE SOME EXAMPLES WHERE THE PROGRAM MANAGER NEVER MET THE PROCUREMENT STAFF AND THE CONTRACTING OFFICER. INSTRUCTIONS AND DIRECTIONS

TO THE CONTRACTOR WERE PROVIDED BY THE CONTRACTING OFFICER WITH SOME INPUT FROM THE CONTRACTING OFFICER'S TECHNICAL REPRESENTATIVE (COTR). THE PROGRAM MANAGER HAD LITTLE OR NO CONTROL OVER THE CONTRACTOR AND THE QUALITY OF PRODUCTS AND SERVICES PROVIDED. NOT ONLY WAS CONTRACTING INEFFICIENT AND MORE EXPENSIVE THAN NECESSARY, BUT IT WAS FRUSTRATING TO THE SCIENTIFIC AND ENGINEERING STAFF AND TENDED TO DEVELOP AN ADVERSARIAL ROLE BETWEEN CONTRACTOR, PROCUREMENT STAFF, AND TECHNICAL PERSONNEL. OBVIOUSLY, THE SOLUTION TO THE ABOVE KINDS OF PROBLEMS IS TO GET THE ATTENTION OF SENIOR MANAGEMENT TO THE EXTENT THAT THE PROCUREMENT STAFF WILL BE ELEVATED TO THE PROPER ORGANIZATIONAL LEVEL AND WILL ALSO RECEIVE ADEQUATE SUPPORT AND COOPERATION FROM THE TECHNICAL PROGRAM PERSONNEL. IN SUMMARY, THE CONCEPT OF OUTSIDE CONTRACTING MUST BE AN AGENCY POLICY SUPPORTED BY ALL HIGHER ECHELONS OF MANAGEMENT.

THE STRONG EXPRESSION OF POLICY BY THIS ADMINSTRATION FOR OBTAINING PRODUCTS AND SERVICES FROM COMMERCIAL SOURCES AND WHICH IS CLEARLY PROMULGATED BY OMB CIRCULAR NO. A-76 (REVISED IN 1983), HAS BEEN HELPFUL TO US IN STREAMLINING OUR CONTRACT PROCEDURES. THE FOLLOWING ARE TWO EXAMPLES OF HOW ADMINISTRATION POLICY CAN BE USED TO STRENGTHEN AN AGENCY'S PROCUREMENT ORGANIZATION AND CONTRACTING PROGRAM.

FIRST, THE CIRCULAR CLEARLY STATES "IT IS THE POLICY OF THE UNITED STATES GOVERNMENT TO ..." RELY ON COMMERCIALLY AVAILABLE SOURCES TO PROVIDE COMMERCIAL PRODUCTS AND SERVICES. IT FURTHER STATES "... THE GOVERNMENT SHALL NOT START OR CARRY ON ANY ACTIVITY TO PROVIDE A COMMERCIAL PRODUCT OR SERVICE IF THE PRODUCT OR SERVICE CAN BE PROCURED MORE ECONOMICALLY FROM A COMMERCIAL SOURCE." IF YOU HAVE SOME FAMILIARITY WITH OMB CIRCULAR A-76, YOU KNOW IT REQUIRES THAT ALL COMMERCIAL/INDUSTRIAL ACTIVITIES MUST BE REVIEWED IN A SYSTEMATIC WAY. UNLESS AN AGENCY CAN PROVE THAT IT IS <u>MORE</u> ECONOMICAL TO PERFORM THE WORK IN-HOUSE WITH

GOVERNMENT PERSONNEL, THEN IT MUST BE PERFORMED UNDER CONTRACT WITH A COMMERCIAL SOURCE. SO, SUCH A STRONG ADMINISTRATION POLICY SETS THE PACE FOR AN AGGRESSIVE CONTRACTING EFFORT WITHIN ALL FEDERAL AGENCIES. OBVIOUSLY, EFFICIENT IMPLEMENTATION OF THE OMB CIRCULAR A-76 POLICY REQUIRES A CAPABLE AND WELL MANAGED CONTRACTING STAFF.

SECOND, OMB CIRCULAR A-76 SPECIFIES THAT EACH AGENCY AND MAJOR COMPONENT ORGANIZATION SHALL "...DESIGNATE AN OFFICIAL AT THE ASSISTANT SECRETARY OR EQUIVALENT LEVEL TO HAVE RESPONSIBILITY FOR IMPLEMENTATION OF THE CIRCULAR WITHIN THE AGENCY." THAT LEVEL OF MANAGEMENT IS NECESSARY TO STREAMLINE PROCUREMENT PROCEDURES AND TO ASSURE THAT NECESSARY RESOURCES ARE PROVIDED TO THE CONTRACTING STAFF FOR EXPEDITIOUSLY IMPLEMENTING THE OMB POLICY. IN ADDITION, THAT LEVEL OF MANAGEMENT CAN DIRECT THE NECESSARY SUPPORT AND COOPERATION FROM TECHNICAL PROGRAM OFFICES. FOR EXAMPLE, I HAVE FOUND THAT STATEMENTS IN THE SES AND MERIT PAY PLANS, WHEREBY MANAGERS ARE PENALIZED IF NOT SUCCESSFUL IN INITIATING AND COMPLETING CONTRACTING EFFORTS ARE VERY HELPFUL.

IN ORDER FOR CONTRACTING TO BE EFFECTIVE AND TO BE A TOOL USED BY MANAGERS, CONTRACTS MUST BE AWARDED IN A TIMELY MANNER AND THEY MUST BE RESPONSIVE TO PROGRAM NEEDS. THE SUCCESS OF A CONTRACTING PROGRAM WILL BE DETERMINED BY MANY FACTORS, SUCH AS ORGANIZATION AND LOCATION OF THE CONTRACTING OFFICE, THE TYPE AND CONTENT OF THE RFP AND SUBSEQUENT CONTRACT, EVALUATION CRITERIA AND THE SOURCE SELECTION PROCESS, AND THE WORKING RELATIONSHIP OF THE CONTRACT TEAM, WHICH INCLUDES THE PROGRAM MANAGER, CONTRACTING OFFICER, COTR, AND LEGAL COUNSEL.

THE LOCATION OF THE CONTRACTING OFFICE SHOULD FIRST AND FOREMOST BE SUCH THAT THE ABILITY OF THE PROCUREMENT PERSONNEL TO INTERACT WITH THE TECHNICAL PERSONNEL IS MAXIMIZED. IF POSSIBLE, THE CONTRACTING OFFICE SHOULD BE

IN CLOSE PROXIMITY TO PROGRAM OFFICES. IN NOAA, WE HAVE RECENTLY ESTABLISHED OUR OWN CONTRACTING OFFICE IN ROCKVILLE, MARYLAND, IN CLOSE PROXIMITY TO MANY OF OUR PROGRAM OFFICES IN THE WASHINGTON, D.C. AREA, AND WE HAVE ESTABLISHED REGIONAL PROCUREMENT OFFICES TO SERVE OUR TECHNICAL FIELD OFFICES.

OUR CONTRACT OFFICE IS ORGANIZED INTO FOUR SECTIONS, THREE OF WHICH ISSUE CONTRACTS. ONE SECTION SPECIALIZES IN AUTOMATIC DATA PROCESSING (ADP) CONTRACTS, BECAUSE THEY ARE SO DIFFERENT FROM GENERAL PROCUREMENTS, ONE SECTION SPECIALIZES IN GENERAL PROCUREMENTS, ONE SECTION HANDLES PROCUREMENTS OF A SPECIAL NATURE SUCH AS A-76, LARGE R&D SYSTEMS, AND OTHER PROCUREMENTS THAT NEED SPECIAL HANDLING. THE PROCUREMENT MANAGEMENT SECTION IS THE ONE SECTION THAT DOES NOT ISSUE CONTRACTS. THIS SECTION REVIEWS AND COORDINATES PROCUREMENTS, PERFORMS COST AND PRICE ANALYSES OF PROPOSALS AND CONTRACTS, AND PROVIDES DATA, SUPPORT, ADVICE, AND CONTROL ON PROCUREMENTS NOAA-WIDE.

THERE IS A NEED FOR THREE SECTIONS ISSUING CONTRACTS BECAUSE OF THE NECESSITY TO BE EXPERT ON THE MANY TYPES OF CONTRACTS, AND TO AVOID HAVING SPECIAL PROJECTS INTERFERE WITH THE ABILITY OF THE CONTRACT OFFICE TO GET OUT THE REGULAR WORKLOAD OF CONTRACTS FOR PROGRAM MANAGERS WHO RELY ON THEM. NOAA IS DOUBLING THE SIZE OF ITS CONTRACT OFFICE STAFF SO THAT THE REQUIREMENTS OF PROGRAM MANAGERS CAN BE MET WITHIN A REASONABLE TIME.

AS AN EXAMPLE OF HOW THE CONTRACT TEAM MUST WORK TOGETHER ON ALL PROCUREMENTS, THE PROGRAM MANAGER ESTABLISHES THE NEED FOR THE CONTRACT, THE COTR IS THE TECHNICAL ADIVSOR AND LIAISON OFFICER TO THE PROGRAM MANAGER, THE CONTRACTING OFFICER AND THE CONTRACTOR. THE LEGAL COUNSEL IS AN ADVISOR TO ALL PARTIES THROUGHOUT THE PROCESS. THEY MUST WORK TOGETHER AS A TEAM. THE PROGRAM MANAGER AND THE COTR MUST HAVE A CLOSE WORKING RELATIONSHIP, AND THERE MUST BE CLOSE COORDINATION BETWEEN

THE CONTRACT OFFICE AND THE PROGRAM OFFICE. OF COURSE, SOME CONTRACTS REQUIRE MORE ATTENTION AND COORDINATION THAT OTHERS. THE LEVEL OF COORDINATION REQUIRED IS DETERMINED BY THE TECHNICAL COMPLEXITY OF THE PRODUCT OR SERVICE BEING PROCURED AND THE TYPE OF CONTRACT INSTRUMENT USED. AN R&D WOULD MOST LIKELY REQUIRE THE MOST ATTENTION. IT SHOULD BEGIN IN THE FORM OF A REQUEST FOR PROPOSALS, WHICH WILL THEN BE RECEIVED AND EVALUATED BY THE SOURCE EVALUATION BOARD (SEB). THE SEB'S EVALUATION IS STRICTLY ON THE TECHNICAL QUALIFICATIONS OF THE OFFERORS. IN AN R&D PROCUREMENT, TECHNICAL FACTORS SHOULD BE WEIGHTED MUCH MORE HEAVILY THAN COST. EVALUATION CRITERIA SHOULD SPECIFY A MINIMUM TECHNICAL SCORE TO REMAIN WITHIN THE "TECHNICALLY QUALIFIED RANGE." OFFERORS WHOSE TECHNICAL SCORES ARE BELOW THE MINIMUM SHOULD BE DECLARED "TECHNICALLY NON-RESPONSIVE" BY THE SEB. FINALLY, THE TECHNICAL EVALUATIONS AND RANKINGS ARE COMBINED WITH COST RANKINGS TO DETERMINE THE COMPETITIVE RANGE, i.e., THOSE FIRMS THAT MOST LIKELY CAN PROVIDE THE TECHNICAL PRODUCT REQUIRED AT A REASONABLE COST. THOSE FIRMS IN THE COMPETITIVE RANGE ARE ASKED TO PRESENT THEIR BEST AND FINAL OFFERS AND THE FINAL RANKINGS ARE THEN DETERMINED. THE SEB AND CONTRACTING OFFICER MAKE RECOMMENDATIONS TO THE SOURCE SELECTION OFFICIAL (SSO), WHO THEN MAKES THE AWARD DECISION. THE AWARD DOES NOT HAVE TO GO TO THE LOWEST PRICED PROPOSAL IN EACH CASE. A HIGHER TECHNICAL SCORE MAY MAKE A HIGHER PRICED PROPOSAL "MORE ADVANTAGEOUS" TO THE GOVERNMENT. THE RESULTING CONTRACT FOR AN R & D PROCUREMENT SHOULD MOST LIKELY BE A COST-PLUS FIXED FEE OR SOME OTHER COST-PLUS INCENTIVE TYPE ARRANGEMENT. VERY RARELY WILL A FIXED PRICE R & D CONTRACT BE THE BEST CHOICE BECAUSE OF THE RISKS AND UNKNOWNS INVOLVED.

ON THE OTHER HAND, FOR AN OFF-THE-SHELF ITEM, THE MOST LIKELY PROCUREMENT WOULD BE AN INVITATION FOR BIDS WHICH WILL RESULT IN A FIXED PRICE CONTRACT. THIS WOULD NOT INVOLVE NEGOTIATIONS, AND, AS YOU MIGHT EXPECT, IS THE PREFERRED

CONTRACT TYPE WHEN THE ITEM IS AVAILABLE ON THE COMMERCIAL MARKET AS OFF-THE-SHELF. THERE ARE NO UNKNOWNS INVOLVED FOR THE CONTRACTOR AND THE GOVERNMENT SHOULD TAKE ADVANTAGE OF THE OPPORTUNITY TO GET A FIRM FIXED PRICE, AND NOT BE EXPOSED TO COST INCREASES.

IN OTHER SITUATIONS SUCH AS IN THE PROVISION OF SERVICES WHICH MIGHT FLUCTUATE IN VOLUME AND ARE NOT WELL DETERMINED PRIOR TO CONTRACT AWARD, A COST-PLUS INCENTIVE TYPE CONTRACT SHOULD BE USED IN MOST CASES.

ONE OF THE MOST IMPORTANT FACTORS IN A CONTRACTING PROGRAM IS INSURING THAT THE PROPER EVALUATION CRITERIA HAVE BEEN ESTABLISHED SO THAT THE GOVERNMENT WILL END UP BUYING WHAT IT REALLY WANTS AND NEEDS. THESE CRITERIA ARE USED BY THE SEB IN EVALUATING THE TECHNICAL CAPABILITIES OF A FIRM TO DO THE WORK AND IN EVALUATING THE RESPONSIVENESS OF A PROPOSAL TO WHAT IS PLANNED TO BE PURCHASED. ONLY THROUGH GOOD EVALUATION CRITERIA CAN BOTH A RESPONSIBLE AND RESPONSIVE CONTRACTOR BE CHOSEN, AND OBVIOUSLY AWARDS SHOULD ONLY BE MADE TO A RESPONSIVE, RESPONSIBLE PROPOSER.

SO, IN CLOSING, I JUST WANT TO SAY THAT NOAA IS REALIZING 30% TO 60% SAVINGS IN DOLLARS AND FTE'S THROUGH CONTRACTING WITH INDUSTRY, BUT THE QUALITY OF THE CONTRACTING PROGRAM IS DETERMINED BY THE INTEREST OF SENIOR MANAGEMENT IN MAKING IT WORK. IF A CONTRACTING PROGRAM DOES NOT RECEIVED THE EMPHASIS FROM MANAGEMENT THAT IT DESERVES, THE RESULTS WILL BE COST OVERRUNS, PURCHASES NOT RESPONSIVE TO PROGRAM REQUIREMENTS, AND OTHER SUCH HORROR STORIES. WE STILL HAVE IMPROVEMENT TO MAKE IN NOAA BUT WE ARE CONTINUING TO MOVE IN THE RIGHT DIRECTION.

CRREL'S COLD REGIONS COASTAL ENGINEERING RESEARCH PROGRAM
Briefing to the COASTAL ENGINEERING RESEARCH BOARD

By: Dr. Lloyd R. Breslau, CRREL

The Cold Regions Research and Engineering Laboratory is a specialized laboratory operated by the U. S. Army Corps of Engineers. Our Laboratory is located in Hanover, New Hampshire, and we have an Alaskan Projects Office in Fairbanks, Alaska. The focus of the Laboratory is on the geophysics and engineering of the world's cold regions as these subjects relate to military operations and construction.

CRREL's most valuable asset is its highly varied and extremely experienced technical staff, which numbers approximately 275, including over 100 professional engineers and scientists. The Laboratory also possesses a large specialized library that works in conjunction with the Library of Congress to access the world's literature on the geophysics and engineering of the cold regions, 26 cold rooms, a large ice engineering model basin for testing ships and structures in ice, a refrigerated flume, refrigerated hydraulic model facilities, and a wide variety of specially designed equipment developed for dealing with snow, ice, and frozen ground problems. In addition a new building is under construction that will permit large-scale experiments on problems of ground freezing.

CRREL, as a full-spectrum Cold Regions Research and Engineering Laboratory, has a long and distinguished record of work on problems related to the science and engineering of the polar oceans, ice-infested lakes and rivers, and cold regions coastal areas. That is because CRREL's staff has had the experience and the specialized equipment and facilities necessary to deal with these unusual problems. CRREL's work in the "Wet Arctic" usually has focused on problems caused by the presence of ice in the system, namely: sea ice, ice islands and icebergs, snow cover, and subsea permafrost.

Because of CRREL's specialized mission and experience, CRREL has, since its inception, served as the Federal research engineer for cold regions problems. By this I mean that CRREL has been involved in almost every major engineering activity undertaken in the polar regions during the last 20 years. For instance, CRREL was involved in the construction of Thule Air Force Base and of Camp Century; in siting the North American DEW line and in its associated ice-bearing-capacity problems; in the design of the foundations for the DEW line stations on the Greenland ice cap, and in their subsequent moves necessitated by snow accumulation; in the ice physics program on the S.S. Manhattan cruises through the Northwest Passage to Alaska; in the design of the Trans-Alaskan pipeline through permafrost regions and in the monitoring of the effectiveness of the designs; in the design of the proposed natural gas pipeline; and in a wide variety of research activities related to the development of the oil and gas resources of the Alaskan outer continental shelf. CRREL is generally acknowledged to be the foremost cold regions research laboratory in the Free World and has frequently collaborated with other Federal agencies where mission's interests intersected. For example, CRREL provided the on-ice ground truth for the Coast Guard's Polar Marine Transportation Project; and the jointly sponsored Coast Guard and Advanced Research Project

Agency's studies on airborne sea ice penetration; and used its ice engineering model basin to assist the Coast Guard in evaluating hull ice deflectors to protect the propellers on the Polar class ice-breaker and to evaluate ice resistance on the Katmai Bay class ice-breaking tug. Additionally, CRREL's arctic expertise is a ready resource that can be rapidly deployed to respond to national emergencies such as Operation "CRESTED ICE" which involved a nuclear armed B-52 crash in North Star Bay off Thule, Greenland.

Now I would like to briefly discuss several different areas of cold regions coastal engineering research that are currently of interest to give you a feel for the differences and similarities between these problems and those encountered in ice-free oceans. The extreme environmental conditions and special characteristics of cold regions areas introduce a unique set of problems that are peculiar to cold regions coastal engineering. Some examples of these problems that must be addressed are:

a. Ice forces on coastal structures.

b. Ice ride-up on shorelines.

c. Ice gouging the sea floor and shoreline.

d. Subsea permafrost's influence on foundations.

e. Spray icing effects on structures.

f. Ice effects on the functioning of coastal installations.

g. Cold regions coastal processes.

Ice Forces on Coastal Structures

As offshore exploration moves from protected shallow-water areas to deeper water covered by highly mobile pack ice, man-made gravel islands, which are currently used for exploratory drilling and are constructed by trucking gravel out to sea using the ice cover as a road, will be replaced by steel and concrete structures that can be fabricated in the lower 48 and towed into position. In deeper waters it will not be possible to cause protective, grounded zones of ice rubble to form around these structures as has been the current ice defense strategy. Instead, the structures will have to be designed to take the ice as it comes. Typical ice drift rates in these areas are 2 to 3 km/day, with peak values of 25 km/day. To develop such designs in a cost-efficient and environmentally safe manner requires high-quality data sets on a wide variety of subjects. Of particular interest are data on the physical properties and constitutive relations for different types of ice, on the thickness distribution of the ice, on its drift velocity, and on the frequency of extreme ice events, such as an ice island impacting a structure.

The lakes and shores of the lower 48 have serious ice problems also. Tides and seiche action jack piles and can make a shambles of a functioning marina in a single season. Ice movement, whether natural or caused by navigation, can destroy heavier structures.

Current CRREL research is focused on the strength of ice in multiyear pressure ridges, the internal structure of first-year ridges, model tests on ice-structure interactions, and the in situ measurement of stress in deforming ice sheets.

Ice Rideup on Shorelines

Ice rideup can pose a threat to our shorelines and structures nearby. Along the Alaskan coast, native homes have been destroyed and coastal structures are vulnerable many meters inland. In winter the action is grandiose and even in summer the aftereffects are impressive. The results of a large rideup are long lasting in permafrost areas. The ice removes the insulating tundra mat thereby allowing the permafrost to melt and the sea to encroach. Ongoing studies at CRREL have not yet come up with a reliable protective measure against this hazard.

Ice Gouging the Sea Floor and Shoreline

As pressure ridges, ice islands, and icebergs drift across the continental shelves of the Arctic, they may ground. This grounding action and the subsequent pushing of the grounded ice mass by the drifting ice pack causes large gouges to form in the sea floor. The existence of this gouging process means that sea-floor installations such as pipelines, cables, and surveillance devices will definitely be in jeopardy in certain areas, unless anti-gouging defense measures are taken. As an aside, let me say that this problem also is present in our lakes, although the ridges and gouges are smaller.

Sea floor gouges have been observed on side-scan sonar records, and gouge-depth measurements made by fathometer instruments. These studies have shown that gouges are both widely existent and deep. For instance, in 30 m of water off the coast of the Beaufort Sea, an average of 80 gouges per kilometer have been observed, with a high of 200 gouges per kilometer. Although deep gouges are not common, they also are not extremely rare. For instance, gouges up to 2 m deep are quite common, a few 4-m gouges have been observed, and 6-m gouges have been reported north of the MacKenzie Delta.

One difficulty in current studies of existing gouges is that there is at present no method for estimating the ages of the gouges, and consequently it is impossible to obtain reliable estimates of the rate of occurrences of these features. This information is essential if an adequate risk analysis is to be made of the respective safety of different pipeline or cable burial depths.

Current CRREL research on these matters is comprised of a cooperative effort with the U. S. Geological Survey in attempting to understand the statistical aspects of ice gouges with the purpose of developing improved stochastic models for gouge prediction and pipeline burial estimates.

Subsea Permafrost's Influence on Foundations

While it is commonly known that permafrost, or "permanently frozen ground," occurs widely in Alaska, its existence north of the Alaskan coastline will come as a surprise to many. Nevertheless, subsea permafrost does exist in some parts of the Beaufort Sea, and its existence must be contended with in order to assure the short- and long-term stability of undersea pipelines and structures requiring sea-floor foundations. If the location and properties of the subsea permafrost can be delineated, appropriate adjustments can be made in offshore foundation design, as well as in oil well casing techniques and drilling procedures.

The existence of permafrost along one north-south transit of the Beaufort Coast is a bit of an historical accident: much of the Beaufort Shelf was above sea level in the geologically recent past, allowing permafrost to form. As the freezing point of sea water is colder than the melting point of pure ice, once the permafrost was submerged it remained relatively stable. However, because of very saline sediments and the near-melting temperature of the sea water, the permafrost located offshore is very unstable. In addition, its thickness is highly variable as is the location of its upper surface relative to the sea floor.

CRREL research on this general problem has been a cooperative effort with the U. S. Geological Survey and has focused on mapping the location of the upper permafrost boundary using industry seismic data coupled with selective coring for verification. We have also been active in studying the physical and chemical properties of this unusual material.

Spray Icing Effects on Structures

This is a rather unique problem in the cold regions environment in that it only occurs under rather restrictive conditions (high winds and waves, air temperatures below freezing, and the absence of an ice cover). Therefore, the spray icing zone is always south of the ice pack in the open ocean. Historically, spray icing problems have been most damaging in the fishing industry, where trawler icing has resulted in the loss of a number of vessels and lives throughout the years. Icing can increase the loading on a semi-submersible drilling platform by hundreds of tons over a short period of time, and it may prove necessary to go to environmentally undesirable procedures to ensure the safety of the rig. For instance, recently in the Shelikof Strait the rig "Ocean Bounty" had to be lightened by dumping drilling mud after it accreted between 300 and 400 tons of ice during one storm. To better forecast such events, improved models are needed, as well as expanded measurements of real icing events on offshore platforms.

Spray icing also covers shorelines, breakwaters, and navigation aids, as in Whitefish Point, Michigan, and can inhibit the use of marinas such as the one at Petosky, Michigan.

As you are probably aware, NOAA is faced with the problem of forecasting spray icing events. CRREL has focused its efforts on the physics of such events and on developing process models to help in such forecasts. We have also been studying a variety of preventative procedures including special ice-phobic materials and coatings.

Ice Effects on the Functioning of Coastal Installations

Water intakes, locks and dams, and docks can have their effective use curtailed by ice. The trash rack has been completely blocked by frazil ice; an intolerable situation for most plants but particularly so for nuclear power plants. Ice in and around the gates of a lock often interferes with gate operation resulting in lock delays of over a half-hour.

Cold Regions Coastal Processes

Erosion and deposition along coastlines occurs worldwide, but there are a few special differences in cold regions. In areas of ice-rich permafrost, dramatic coastline retreat commonly occurs at a rate of 10 to 20 meters/year, and a rate of 30 meters/year has been observed. The shoreline is protected from wave erosion during periods of ice cover. But in the Arctic this can lead to surprising erosion rates when winter storms occur before the ice cover is secure.

In summary, activities are accelerating in the offshore Arctic regions prompted by energy and national defense considerations. CRREL has the unique capabilities to respond to these needs and has so demonstrated over the past 20 years. Our staff of engineers and scientists, who are knowledgeable in all aspects of Arctic research and capable of conducting operations in this hostile environment, are a resource that can be brought to bear to meet the challenges of the future.

This concludes my formal briefing. However, let me leave you with two thoughts: CRREL personnel are familiar with all aspects of the Arctic environment and can tame any obstacles that they may encounter there!

NED RESEARCH NEEDS*

By Lawrence Blake

MR. BLAKE: I'd like to very briefly and generally go over NED's research needs, the types of things that we need and what we're looking at. We do sincerely believe in New England that we do have an element of uniqueness in New England. Part of that is summarized in the theme of this meeting -- the wave energy and sheltered areas. And it's not that other Districts and Divisions in the Corps don't have sheltered areas, it's just that New England is predominantly sheltered areas.

I think earlier on Tuesday, some of my comments relate back to Tuesday presentations. Tom Bruha had mentioned that geologically we are a little different than the rest of the country. Politically we're a little different. We have so many entities to deal with, and every one of those entities has a say in what we do.

And as you recall the spaceship traveling down the coast, another outstanding element of New England coastline is its tortuous nature. The spaceship traveled 44-4500 miles, yet

* Excerpt from transcript of 40th CERB Meeting.

we have 6100 miles of coastline. It's a very convoluted type of coastline. All of this has an impact on the coastal processes and the types of solutions that we can come up with for these coastal problems.

I'd like to lump some of these needs that we have into some general areas. First and foremost on the list is that we do need some data bases, something to give us a little more reliable basis for our designs. This was mentioned. Doctor Fessenden had mentioned it Tuesday that we were in need of this, and those of you who attended the poster session on Tuesday evening, Dr. Aubrey had mentioned his surprise in coming from the south California coast and coming to New England that there were no data bases to work off of at all. And many of our own people perceive this as a problem. We do not have the basis to come up with reliable, predictive, definitive designs. We have to work with whatever is available.

Chuck Wener had spoken also in the day earlier on Tuesday about the wind program that we're working on. We don't have the wave data programs and sand transport data programs. However, we can get our hands on some wind information. We're trying to massage that to fill in that gap where we're missing solid wave data.

Another area of technical need would be having access to hardware, and I'll jump down to the bottom, also developing hardware. Coastal testing instruments. Coastal monitoring devices are expensive. They're expensive to procure, to install, to operate and maintain and expensive to retrieve. I'll mention this a little later when it ties into the funding. But many of our projects we can't afford to go out and buy this equipment, and yet we must have access to it to be able to establish the data bases to do that definitive reliable design.

There are elments of hardware that could be developed. Before this meeting, I had polled some of my people and said, "Well what are you interested in? If money was no object and priorities were no problem, what are some of the things you would need?" And some of the things that did come up were more automated hydrographic surveying. Dredge disposal monitoring. Not along the line that was spoken on the dredge disposal program, the capping operation, but some of our people in construction have a problem with money, manpower, overtime restrictions where we put an inspector on every dredge that goes out, and it becomes very expensive, and one way or the other the costs come back to us. As we cut people, as we cut expenses, as we put caps on things like overtime, this becomes a problem. This was an area of hardware development that was identified.

We also have a need to adapt existing products, computer programs, design aids, curves, and to develop new products. Again I could go through some of the laundry list, the grocery list that was given to me. Some people are looking for a standard nor'easter tide program. Project hurricane tide models. Some people are concerned with the cold temperatures and icing, ice and icing on our structures and on the coastal processes.

We're looking for a safe economical rehabilitation or repair of structures. I hope that REMR program might address this. But we do have a problem. For instance, just in monitoring projects, you go to put a survey man out on a breakwater, and you want a reliable, fairly accurate picture of what that breakwater looks like. If you're not careful, you're going to lose a man out to sea if a wave comes up while he's trying to catch certain holes in the breakwater, and we could lose him. We need something that's safe yet economical to be able to assess the condition of these structures out in the coastal environment.

Another concern we have with adapting and developing products, the existing products and new products, is the verification of these products. Much of the verification that goes on is done at Duck, North Carolina. It's performed on the Florida coast and the California coast, and because of what we feel is New England's uniqueness, there's a question of whether some of the programs and the models that are being developed do apply to New England's situation. But much of the verification of this is going on in an area that's not subject to the same conditions that we have.

Of course, this will begin to trace

back through, trying to verify designs to see if all the model constraints and parameters do apply, we need to monitor our coastal processes, our coastal structures. Either we've got to do it, at which point we must access the hardware or someone's going to have to do it for us. But we don't have the data bases and the data bases aren't being developed to do this.

So we're still left with the question, do these products apply to us? Now, I realize reading through the literature that much of what has been done is termed, I think, first generation models, where they tend to be a conceptual model. They tend to deal with very simple types of waves, and the research that will be coming up has been termed, I think, second generation models. It's going into a lot more detail. It's beginning to quantify. That's fine. These are some of the things we're looking for, but we're still considering, will these models apply to us, because they were checked and verified under conditions that aren't quite the same as what we have.

New England is primarily -- we have

shallow waters. We have very narrow fetches, a very high degrees of refraction and diffraction, and some of those were brought out in the presentations Tuesday, for instance, the presentation on Willard Beach with the islands sheltering the beach. And we found that the south end of the beach was entirely different than what would have been expected. These types of concerns of how often do things like this happen when there are processes going on that are entirely different than what the models would predict.

The overtopping at Revere Beach was considerably less than what had been predicted by the model studies. We need to be able to verify and be sure that for our uses or at least be comfortable with the models and programs that are coming out.

Basically NED has three avenues of solving -- with the civil works R&D programs, there are three avenues open to us for solving our problems. The research needs system, the one-stop R&D service, and the reimbursable workorders.

I'll take these one at a time. Some of the difficulties we have found in the past is when it's the structural deficiencies with the research needs system, and I think much of this has been documented. There was quite a study done two years ago by the Water Resources Study Center on the problems with assessing priorities in the research needs system.

I've got listed down there Limited Utility. By utility, I mean the ability of the research needs system to satisfy our needs and our wants. One obviously is the response time. The RNS is a long-term solution, yet many of our problems are project specific. They need to be answered within a year or within a few months or a one year or two years. The research needs system, if you can get an answer in a year, you're doing good. But then I don't think the research needs system was designed to handle short-term or intermediate-term solutions.

There's also a problem with trends. There's quite an inertia when it heads in one direction, and things outside that main thrust, it doesn't do well with dealing with, because there's so much capital investment and time and equipment and people in one particular area.

There's also the question of regionality versus generality. In the last three or four years NED has submitted perhaps three mission problem statements in the coastal area. They have all been rejected, and the common reason is that it is felt that the problem was more regional in scope and did not have a Corps-wide application. Yet if we are a little bit different in our needs than everyone else, then how do we have problems solved using the research needs system?

The next area is the one-stop R&D service. Generally this is very well received in NED. And I would say of all the research areas, this is perhaps more heavily used by people in the coastal disciplines than any other area. Some of the uses, some people have used this as often as three or four times a month. They make a fairly good use of the program. However, it also has its constraints in that coastal problems tend to be very complex in nature. Particularly if you're lacking certain basic information about the coastal environment.

In one of two days of man effort,

you can't get into too much depth on a particular coastal problem. So a lot of your answers are limited to a very superficial question or a very detailed type of question, a very small aspect of a design. The time is just not there to get into any depth.

I've also lumped under this the field visits where CERC came up and visited NED or NED went down to visit CERC, and these proved to be very helpful. For one thing, if a lot of technical information did not come out of them, it gave CERC an appreciation for NED and NED an appreciation for CERC, just the types of problems and nature of our problems and to develop some contacts in the labs, people you could talk to and you'd know on a first name basis. In general we have been very happy with this service.

DR. CHOROMOKOS:* Can I explain this one-stop service? This is a service that we provide in the laboratory to customers, not only Corps customers but to other people that we -- it's up to two days of consulting work, and it's free, and we just provide this as one of our transfers. It don't cost NED or any of the others.

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* OCE.

It comes out of the laboratories' overhead, so there are no "R&D" dollars directed toward this, and I think the latest thing that I saw was in the nine months of the last fiscal year, we had a total in all of our labs, including Coastal Engineering, about 8000 of these one-stop services. And it's more than just a telephone call. It's up to two days of work.

GENERAL EDGAR:* Larry, if I could interrupt.

Let me ask you, Jim,** if I might, if you would comment, please, on Larry's concerns about the research needs program and some of the mission statements that NED has submitted but were rejected because they were regional in nature as opposed to national in scope. How does a Division, be it NED or some other Division, that has a problem peculiar to this get their problem addressed?

DR. CHOROMOKOS: Would you like me to answer that now?

GENERAL EDGAR: Please, if you would.

DR. CHOROMOKOS: I'll turn it right

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* CERB.

** Choromokos.

to Dr. Roper who sits on that particular civil works research needs system. I do not sit on that particular board, and Dr. Roper does. I have my ideas on it but I'll let Dr. Roper give you his ideas.

COLONEL CREEL:* I'll give you my ideas later too.

DR. ROPER:** General Edgar, I think the main concern here is that we have -- as you know, in Coastal Engineering we have a very limited number of R&D dollars, and we have in fact tried to concentrate those dollar on projects that have more of a Corps-wide application. And in those sessions where we do look at the program on an annual basis and go over the needs that have been submitted by the various Districts and Divisions as well as from Headquarters, the consensus of that reviewing group has been to allocate the dollar in the more general areas to get a larger overall payoff to the Corps. It just doesn't come up in the priorities.

I can associate with the problems that NED sees from the way the priorities have come out in past years. That doesn't mean that

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* WES.
** OCE.

their priorities may get higher up on the list as we go through it in the future. But they have not come up in the past.

GENERAL EDGAR: Okay. Til, you may want to comment. The concern that I'm getting, though, is how does the field, the Division get a handle on this? They're asking for help. They don't have the research capability. OCE is saying your problem isn't broad enough for national application. The problem still exists in the field. They're still wrestling with it, and there doesn't seem to be a solution. They don't have the R&D dollars to do the work. Til?

COLONEL CREEL: Well, I'd like to comment on the fact that I think that a meeting up here in New England at this time is extremely good. Primarily because you have the people here who are going to make those kinds of decisions. You have the tech monitors down here sitting behind us. You have Dr. Roper and Dr. Choromokos and certainly others in the room. So therefore, New England's needs are going to get felt, and by seeing them, I think we have a better appreciation for the problem.

I think the answer is the dollar has been short. I do feel by moving CERC to WES, we are going to make a better use of the dollar because of the reimbursable issue. And I think that's where New England is going to have to -- if they can not sell it to Civil Works, that the problems that you have there are in fact of a general nature, then you're going to have to do it under the reimbursable.

Now, that means again you're going have to go fight, the Division Engineer's going to have to go fight with Civil Works to try to get that kind of money out. I think that you're going to have a more receptive audience, very honestly, after seeing. That may sound like who gets last seen gets the most money, but I have a feeling that occasionally happens.

GENERAL EDGAR: I see my good friend Jim Van Loben Sels sit up in his chair when you made that comment. I can sense Tom Sands' attention as well.

(Laughter.)

We'll bear that all in mind.

Bob Teeters,* I think you had a

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comment.

MR. TEETERS: I think that the problem that you pose here is a general one that we have in the research assessment priorities setting system that we have. We are trying very hard to put our money on the general programs.

If you have a lot of projects, I think that regional needs can be in a sense generalized out of reimbursable work that's done on this project, that project. I take it, your problem is one in which you don't have project funds to get reimbursable work done for you, and you're getting a deaf ear or maybe not a sufficiently tuned ear on your regional problems.

You don't suffer this alone. I think we probably need in Civil Works to try to see if we can't accommodate this a little bit better. I don't know what the answer is, but I've heard sort of comparable complaints in other fields too. So I think we've got a system problem that we need to look at.

GENERAL EDGAR: I think General Sand has a comment.

GENERAL SANDS:* Yes, I do. I guess

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* CERB.

this is addressed to the Chief of R&D and representatives of Civil Works and the Board. From what I've heard so far it seems that the methodology for assigning the research dollars is based on the national applicability of the results of the research rather than the magnitude of the problem to be addressed. Is that basically right?

MR. TEETERS: Not quite. The other would, I think. I would say that the magnitude of problem is also a factor, but in a generality it's certainly probably predominant.

GENERAL SANDS: But it seems to me that you're going to find some situations where a very, very regional problem is of such magnitude that it should become extremely important to the Corps of Engineers to solve it.

GENERAL EDGAR: I think that's a good point, Tom.

Without anyone feeling like they're getting their comments cut on in general session, we do have a time schedule to meet. Let me suggest, Larry,* that you get together with Bill Roper and Bob Teeters to discuss things on a more individual basis, so that the points that you wish

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* Blake.

to make you can get across, and we clearly have a problem broad and specific to address in the R&D arena in Civil Works. And we can tell you certainly that we're going to take another look at it.

MR. BLAKE: This was addressed. The third avenue is the reimbursable or where we go out and we buy the services with our own project funds.

I will bring up one more problem, and again it's something not peculiar to NED, and that's the predominance of small projects. A few years ago NED may have been an exception with its small projects. I think we're the rule now, since small projects programs are growing across the country. Colone Sciple referred to our own program and how much it has grown.

And the problem with the small project is a lot of it is in funding. The project itself is not large enough, and there's not enough fat in the project. Because it's so small you can't justify a large investigative effort. When you're coming off a program that you have no data bases to fall back on, you have a lot of prior experience and verification, you're starting from scratch. The small projects won't support that, and a lot of our funding is done on a project-by-project basis.

They also tend to be very quick. A lot of the small projects can run up to maybe a couple of years. That's not enough time to identify a need, go out, collect all your information, assess the information and then put it into a design. By that time your efforts should have been done and whatever you've built is in the ground or in the water by that point.

Small projects also cause us an inability to compete with larger projects across the country. Other Districts and Divisions who do have a large project and they are going out to buy R&D time, effort and resources. And it would be understandable that the labs would go with the larger client. But then again that leaves us a bit in the cold. How do we satisfy our needs that we have?

I'll just gloss over the last one because we've run out of time. We have had some good experiences with our reimbursable work efforts. We have had some that we're not quite happy with. It took too long to get an answer or not much was told that we didn't already know.

Very quickly also, there are occasions when we will go to outside people -- consultant, universities -- for information, for services other than the lab system. Of course this suffers from the same constraints that the reimbursable workorder does. The projects are short. There's not much money involved, and they tend to be of small scope, a very specific type project. But on occasions we do go to the outside.

In summary, NED has needs. That is supposed to be "Good Experiences and Bad Experiences." I was at an instructors' meeting last week and I didn't have time to --

GENERAL EDGAR: I thought you were trying to emphasize a point.

(Laughter.)

MR. BLAKE: I was afraid you might think that. We do feel that more consideration should be given small projects. Again, this is not a problem peculiar to NED. But a problem that is growing Corps-wide. How do we handle our small project programs. More consideration of projects that find themselves outside the main thrust of current R&D of things that have been defined in the research needs system.

That's the end the presentation portion. If there are any additional questions.

GENERAL EDGAR: Any questions by the Board?

PROFESSOR WIEGEL: We can come back in the general discussion.

MR. BLAKE: Yes, we can come back to them.

PROFESSOR WIEGEL: Because you posed a general problem.

MR. BLAKE: Yes, I have.

GENERAL EDGAR: Thank you, Larry.

MR. IGNAZIO'S SPEECH

REGARDING NEW BEDFORD HURRICANE PROJECT

BEFORE THE CERB MEETING

18 OCTOBER 1983

LADIES AND GENTLEMEN, I AM DELIGHTED TO REPORT TO YOU THIS MORNING UPON ONE OF OUR MORE UNIQUE, IMPRESSIVE, AND SUCCESSFUL CIVIL WORKS PROJECTS ACCOMPLISHED BY THE NEW ENGLAND DIVISION. I AM PERSONALLY PLEASED IN THAT THIS ASSIGNMENT WAS ACTUALLY THE REASON FOR MY JOINING THE CORPS 28 YEARS AGO IN NOVEMBER 1955. AT THAT TIME I HAD BEEN ENGAGED IN THE PRIVATE ENGINEERING SECTOR AND WORKED FOR SOME FOUR DIFFERENT FIRMS, ONE OF WHICH WAS STONE & WEBSTER. THE CORPS HIRED ME AS A STRUCTURAL ENGINEER AS THE DIVISION WAS GOING TO TAKE ON AN ASSIGNMENT OF A MAJOR NAVIGATIONAL GATE STRUCTURE, AND UP TO THAT POINT OF MY CAREER I HAD WORKED ON BUILDING AND HEAVY BRIDGE DESIGN. ACCORDINGLY I ACCEPTED THE JOB AND AS MY FIRST ASSIGNMENT WAS GIVEN THE STUDY PHASE OF THE NEW BEDFORD HURRICANE BARRIER PROJECT, AND, MORE SPECIFICALLY, THE CONCEPT PLANNING FOR A NAVIGATION GATE.

IN THE 15 MINUTES ALLOTTED TO ME I WILL PROVIDE YOU A VERY BRIEF OVERVIEW OF SOME OF THE THINGS THAT CONCERNED US SOME OVER THE 28 YEARS AGO WHEN THE PROJECT WAS BASICALLY AN IDEA AND IN THE PLANNING STAGE.

THE NEW BEDFORD PROJECT WAS COMPLETED IN JANUARY 1966 AT A COST OF $18,024,000, OF WHICH SUM $11,510,000 REPRESENTED THE FEDERAL SHARE, AND NON-FEDERAL INTEREST PAID $6,514,000. HURRICANE PROTECTION AT THAT TIME WAS LEGISLATED BY CONGRESS TO HAVE A COST-SHARING REQUIREMENT OF 70/30.

IN ADDITION, AND WISELY SO, THE NON-FEDERAL INTEREST MADE A LUMP SUM PAYMENT OF $1,520,000 IN LIEU OF TAKING ON ANNUAL O&M COST CONSIDERED A LOCAL REQUIREMENT AND ACCOMPLISHED THROUGH NED'S CAPE COD CANAL OFFICE ON A REIMBURSABLE BASIS.

THE HURRICANE PROJECT WAS AUTHORIZED 8 YEARS EARLIER BY THE CONGRESS IN THE 1958 FLOOD CONTROL ACT. CONSTRUCTION BEGAN IN 1962, AND IT TOOK 4 YEARS TO COMPLETE.

MY REMARKS WILL CONCENTRATE LARGELY ON THE BARRIER CLOSURE AND THE NAVIGATION GATE AS THERE ARE OTHER SEGMENTS OF THIS IMPORTANT PROJECT. AS YOU CAN SEE FROM THIS SLIDE THE BARRIER IS SIZABLE. IT IS THE ONLY TIDAL COASTAL BARRIER THAT I AM AWARE OF IN THE UNITED STATES THAT SEALS OFF A COASTAL TIDE ESTUARY. IN TODAY'S ENVIRONMENT MANY HAVE WONDERED WHETHER WE COULD EVER GET SOMETHING LIKE THIS BUILT TODAY AND THAT IS A GOOD QUESTION.

THE PROJECT WAS VERY SUCCESSFUL FROM A PLANNING ASSIGNMENT, BY THAT I MEAN STRONG LOCAL AND STATE SUPPORT AS WELL AS OTHER FEDERAL AGENCIES. THE DESIGN PHASE WENT SMOOTHLY AND SO DID THE CONSTRUCTION PHASE WHICH INVOLVED THE MARINE DIVISION OF THE PERINI CORPORATION. IT'S BEEN REALLY LARGELY A TROUBLE-FREE OPERATION OVER THE PAST 17 YEARS OF EXISTENCE. THE PROJECT HAS BEEN AN IMPORTANT RESOURCE AND ASSET TO THE NEW BEDFORD AND FAIRHAVEN COMMUNITIES.

FOR EXAMPLE THE EXTENSIVE COMMERCIAL FISHING ACTIVITIES OF NEW BEDFORD AND ITS MYRIAD OF PROCESSING PLANTS WITH PRODUCTS WHICH GO ALL OVER THE UNITED STATES AND EUROPE, AS WELL AS THE NORTH ATLANTIC

COMMERCIAL FLEET HOUSED ALONG THE FAIRHAVEN SIDE, WOULD BE HARD-PRESSED WITHOUT ITS PROTECTION . MACHINE SHOPS, BOAT YARDS, MARINE RAILROADS ARE LOCATED ALONG THE FAIRHAVEN COMPLEMENT AND SUPPORT THE FLEET'S NEEDS. THE STRUCTURE PROVIDES A LARGE AMOUNT OF FLOOD PROTECTION FOR THE TWO COMMUNITIES; FLOODS WOULD OTHERWISE BE EXPERIENCED BY REASON OF COASTAL STORMS. MANY MILLIONS OF DOLLARS OF PRIVATE INVESTMENT HAVE BEEN EXPENDED SINCE ITS COMPLETION. TO GIVE YOU AN ORDER OF MAGNITUDE ..... ALONG THE NEW BEDFORD SIDE WE HAVE THE RECENT CONSTRUCTION OF THE NORTH TERMINAL AND THE SOUTH TERMINAL; THE MAJOR WATERFRONT URBAN RENEWAL PROJECT INCLUDING RESTORATION OF OLD BUILDINGS AND WATERFRONT PROPERTIES; A MAJOR HIGHWAY ACCESS SYSTEM SO THAT PEOPLE COULD EASILY FIND THEIR WAY INTO THE CITY'S HISTORIC AND CULTURAL PAST AS A CENTER OF AMERICAN WHALING INDUSTRY. IN ADDITION, EXTENSIVE SEWER SYSTEM IMPROVEMENT INCLUDING INTERCEPTORS THAT WERE PERENNIALLY SUBJECTED TO TIDAL FLOODS ARE NOW LARGELY SECURED AND IMPROVED THROUGH EPA STATE GRANTS, WHICH HAS RESULTED IN A GENERAL UPGRADING OF WATER QUALITY. I AM UNABLE TO GIVE YOU A DOLLAR TALLY OF THE LARGE MILLIONS INVESTMENT THAT WERE TO A GREAT EXTENT MADE POSSIBLE BY THE $18,000,000 HURRICANE BARRIER. IF EVER AN $11,500,000

PUBLIC WORKS PROJECT PAID OFF IN HANDSOME DIVIDENDS IT HAS TO BE THE NEW BEDFORD BARRIER. IT WOULD MAKE AN INTERESTING STUDY FOR SOME DOCTORAL OR GRADUATE STUDENT TO TRACK THIS TYPE OF INVESTMENT.

THE NAVIGATION GATES THEMSELVES HAVE OPERATED 85 TIMES SINCE COMPLETION. THE MORE IMPORTANT OPERATIONS OCCURRED IN NOVEMBER 1972 AND 9 JANUARY 1978 AND THE BLIZZARD OF FEBRUARY 1978. THESE NEXT SLIDES PROVIDE YOU WITH THE LAYOUT OF THE BARRIER AND GATES AND HOUSING AND THE ACTUAL GATES THEMSELVES IN AN OPEN POSITION AND CLOSED POSITION. THE DEPTH AND WIDTH OF THE IMPROVED CHANNEL THROUGH THIS REACH ARE 30 FEET AND 350 FEET WIDE, RESPECTIVELY. AT THE BARRIER THE OPENING REDUCES THAT WIDTH TO 150.

OVER THE MORE THAN 300 YEARS SINCE THE LANDING OF THE PILGRIMS, ABOUT 70 HURRICANES HAVE BEEN RECORDED IN NEW ENGLAND REGION, OF WHICH 38 CAUSED TIDAL FLOODING. THE MOST NOTABLE EVENTS WERE SEPTEMBER 1938 AND AUGUST 1954. THEY PRODUCED RECORD STAGES AND THEY WERE ALMOST COINCIDENT WITH HIGH TIDES.

IN DEVELOPING A DESIGN HURRICANE BARRIER AND ITS RELATED COASTAL ENGINEERING FEATURES, THE FOX POINT BARRIER IN PROVIDENCE, RHODE ISLAND, WAS USED AS A REFERENCE POINT. HURRICANE STUDIES WHICH BEGAN IN JULY 1955 INVOLVED A CONTRACT WITH TEXAS A&M FOR THE PREPARATION OF A DESIGN STORM INCLUDING TIDE AND WAVE HEIGHTS FOR HURRICANES OCCURRING ALONG THE SOUTH SHORE OF NEW ENGLAND. THE WATERWAYS EXPERIMENT STATION AT VICKSBURG WAS ALSO TASKED TO CONSTRUCT A PHYSICAL MODEL OF NARRAGANSET BAY. THE DESIGN STORM, OR STANDARD PROJECT HURRICANE, WAS ALSO DEVELOPED WITH ASSISTANCE FROM THE U.S. WEATHER BUREAU AND THE BEACH EROSION BOARD AIDED BY THE TEXAS A&M RESEARCH FOUNDATION. THE DESIGN STORM WAS BASED ON THE TRANSPOSITION OF THE SEPTEMBER 1944 HURRICANE. THIS STORM AS IT OCCURRED OFF CAPE HATTERAS WAS THE LARGEST HURRICANE OF RECORD. THE DESIGN STORM CRITERIA WAS ESTABLISHED BY ENVELOPING OBSERVED HURRICANE PARAMETERS, SUCH AS CENTRAL PRESSURE AND RADIUS OF MAXIMUM, AND SMOOTHING THESE FORCES GEOGRAPHICALLY. THE 1944 HURRICANE WAS TRANSPOSED TO TRAVEL OVER WATERS BETWEEN CAPE HATTERAS AND THE NEW ENGLAND COAST. THE PATH OF THE STORM'S EYE WHICH CAUSED THE HIGHEST TIDE IN NARRAGANSET

BAY IS ABOUT 54 MILES WEST OF THE BAY AND IS ALONG THE COURSE OF THE CONNECTICUT RIVER. CHARTS OF THE TRANSPOSED 1944 STORM WERE PREPARED FOR VARIOUS RATES OF FORWARD SPEED RANGING FROM 10 TO 60 KNOTS. THE 1944 STORM WAS ALSO SELECTED FOR THE CALCULATIONS OF SURGE HEIGHTS, WHICH ARE COMPOSED OF TWO COMPONENTS, NAMELY, THE GENERAL RISE OF SEA LEVELS PRODUCED BY THE LOW-PRESSURE AREA ASSOCIATED WITH THE HURRICANE EYE AND THE WIND SETUP OR ADDITIONAL RISE IN SEA LEVEL PRODUCED BY ONSHORE WIND OR THE STORMS BLOWING OVER FETCH BETWEEN THE CONTINENTAL SHELF AND THE SHORE ITSELF. THE SURGE HEIGHT GENERATED BY THE WIND IS USUALLY THE MAJOR OF THE TWO COMPONENTS.

THE RECORD SEPTEMBER 1938 HURRICANE SURGE USED AS A BASIS FOR STUDIES TO DETERMINE THE DESIGN SURGE AT THE MOUTH OF NARRAGANSET BAY FOR CALCULATIONS LED TO A DESIGN SURGE OF 17.4 FEET; 11.2 FEET TABULATED AT NEWPORT, RHODE ISLAND, 3.3 FEET FOR DYNAMIC BUILDUP AT NARRAGANSET BAY AND A 2.9-FOOT WIND SETUP FOR THE BAY ITSELF. THE TOTAL SURGE WAS APPLIED TO A COINCIDENT MEAN SPRING HIGH WATER OF ABOUT 3.1 FEET MEAN SEA LEVEL, RESULTING IN 20.5 FEET AS COMPARED TO OBSERVED LEVELS OF 15.7 FEET FOR THE 1938 HURRICANE. WAVE HEIGHTS WERE ADDED TO THIS. A SIGNIFICANT WAVE OF 6.5 FEET WITH A PERIOD OF 5.5 SECONDS WAS UTILIZED.

THE STORM SURGE FOR NEW BEDFORD WAS BASED ON THE VALUES COMPUTED AT THE MOUTH OF NARRAGANSET BAY. APPLYING THESE FACTORS, THE '38 SURGE AT NEW BEDFORD RESULTED IN DESIGN SURGE OF 13.1, AND ADDING THIS TO A COINCIDENT PREDICTED SPRING HIGH TIDE PRODUCED A STILL-WATER LEVEL OF 16 FEET. THE MAXIMUM DESIGN WIND VELOCITY OF NEW BEDFORD WAS 100 MILES AN HOUR, PRODUCING SIGNIFICANT WAVE HEIGHTS OF 8-9 FEET OVER A PERIOD OF 6.4 SECONDS. A 9-FOOT WAVE HEIGHT IS APPLICABLE TO ALL STRUCTURES FACING SOUTH. TOP ELEVATION OF THE PROJECT VARIES FROM 17 FEET MEAN SEA LEVEL ON THE INLAND PORTIONS TO 23 FEET ON SECTIONS FULLY EXPOSED TO MAXIMUM FORCES. WAVE RUNUP AND OVERTOPPING WERE DEVELOPED USING THE SAME METHODS AS DEVELOPED AT FOX POINT.

THE NAVIGATION OPENING WAS SELECTED PRIMARILY TO SATISFY NAVIGATIONAL REQUIREMENTS, AND IT WAS CHECKED TO DETERMINE THE EFFECT THIS OPENING WOULD HAVE ON TIDAL ELEVATIONS AND ECOLOGICAL CONDITIONS IN THE HARBOR. THE AUTHORIZED 30-FOOT-DEEP 350-FOOT-WIDE NAVIGATION CHANNEL PROJECT EXTENDS INTO NEW BEDFORD HARBOR. STUIDES OF THE TYPE AND SIZE OF VESSELS IN USE OF THE WATERWAY REVEALED A 150-FOOT NAVIGATION OPENING ADEQUATE.

CLOSURE OF THE BARRIERS IS EFFECTED BY TWO SECTOR GATES, EACH WEIGHING 400 TONS AND CONSIDERED TO BE THE LARGEST IN THE WORLD. THE GATE IS 93 FEET IN ARC LENGTH AND 59 FEET HIGH AS IT ROTATES ON VERTICAL AXIS. THE GATES CAN BE CLOSED IN 12 MINUTES.

THE DESIGN LEADING TO THE SECTOR GATES EVOLVED FROM STUDIES OF OTHER GATE SYSTEMS IN THE COUNTRY AND IN OTHER COUNTRIES, FOR EXAMPLE, JAPAN, HOLLAND, AND ENGLAND .... WE LOOKED AT INITIALLY FLOATING CAISSON DESIGN GATES, AS WELL AS MITRE GATE, ROLLING GATE, AND OTHER RAMIFICATIONS OF CLOSURE.

THE CLOSURE REQUIREMENTS, WHICH AT THAT TIME WERE GIVEN AS 20 MINUTES, TO A LARGE EXTENT DETERMINED THE FINAL SELECTION AS TO TYPE OF GATE. THE SECTOR GATES GAVE US THE ABILITY FOR TIMELY CLOSURE AND CONTROL OF THE STRUCTURE. THE WELFARE OF THE FISHING FLEET AND OTHER NAVIGATIONAL CRAFT REQUIRING ACCESS INTO THE HARBOR FROM HURRICANE SURGES AND WAVE ATTACK WERE CRITICAL. WITH ASSISTANCE FROM EXPERTS IN THE CHIEF'S OFFICE AND OF CERC PEOPLE LIKE MR. SMITH, JOE CALDWELL, AND IN PARTICULAR DR. SAVILLE, WE CAME UP WITH THE SECTOR GATE AND STONE BARRIER AS CONSTRUCTED.

THE SECTOR ARC EVENLY DISTRIBUTED THE LOADING TIDAL SURGE AND, IN MY EARLY DESIGN COMPUTATIONS OF THESE LOADS TOGETHER WITH DYNAMICS OF WAVE ATTACK, I WAS ABLE TO TRANSMIT LOADING AND STRESSES INTO TRUSSES AND THEN BACK TO HINGE POINTS AND QUOIN SEAT IN A PROPORTIONATE MANNER. WITHOUT HAVING DISPROPORTIONATE LOADING WE DID NOT HAVE TO RELY ON HIGH-ALLOY STEELS THAT WOULD HAVE CAUSED US OTHER PROBLEMS IN WELDING, AND FABRICATION THE ACTUAL STRUCTURAL DESIGN WAS RATHER SIMPLISTIC. THE PROJECT IS ALSO EASY TO REPAIR. THE PROJECT DOES INCLUDE CATHODIC PROTECTION WHICH HAS LENGTHENED LIFE OF THE METAL AND REDUCED NEEDS FOR PAINTING.

THE BARRIER CLOSURE IS CONTROLLED BY NED'S RESERVOIR CONTROL CENTER IN WALTHAM. IT WORKS CLOSELY WITH OUR PEOPLE AT CAPE COD CANAL OFFICE IN DETERMINING CLOSURE TIME PERIODS. THE FORECASTING AND REQUIRED TIME NECESSARY TO NOTIFIED OTHERS ARE CLOSELY DEVELOPED.

WE HAVE YET TO EXPERIENCE PROBLEMS OR OCCURENCES WHICH HAVE IMPACTED ADVERSELY UPON SHIPPING INTERESTS.

THE DIVISION IS MOST PROUD OF ITS ACCOMPLISHMENT AT NEW BEDFORD. THE REGION RESPECTS THE TECHNICAL TALENTS OF THE CORPS IN DEVELOPING A

PROJECT OF THIS MAGNITUDE WHICH PROVIDES THE SECURITY AND COMFORT TO THE COMMUNITIES OF NEW BEDFORD AND FAIRHAVEN AND HAS ENABLED OTHER IMPORTANT DEVELOPMENTS IN THE QUALITY OF LIFE OF THAT REGION TO COEXIST. WE HAVE YET TO EXPERIENCE THE MAJOR DESIGN HURRICANE THAT THE PROJECT WAS BUILT FOR - IT HAS WORKED SUCCESSFULLY IN OTHER COASTAL EVENTS, AND ABOUT 30% OF ITS COST WAS RECOVERED. WE HAVE LEARNED THROUGH OUR OPERATION: INCLUSION OF COMPRESSOR HOUSES WITHIN THE ABUTMENTS TO BLOW OUT SEDIMENTS ALONG THE SILL WHICH WERE AFFECTING WHEEL MOVEMENT HAS BEEN ACCOMPLISHED AT THE BOTTOM OF THE GATES. THESE WHEELS WERE RECENTLY REPLACED BECAUSE OF METAL CORROSION AND STRESS. BY AND LARGE EVERYTHING HAS WORKED QUITE NICELY. THE STRUCTURE ITSELF - THE TRUSSES, THE SHEETMETAL, SKIMS, THE GEAR, RACK AND PINION, HAVE WITHSTOOD WELL THE ELEMENTS OVER THE LAST 17 YEARS.

THIS COMPLETES MY PRESENTATION - I KNOW YOU WILL ENJOY SEEING THIS PROJECT. I'LL BE HAPPY TO ANSWER QUESTIONS YOU MAY HAVE.

THANK YOU VERY MUCH.

APPENDIX B: DIRECTORY OF NED EMPLOYEES IN ATTENDANCE AND GUEST SPEAKERS

Name	Organization	Telephone No.
NED Speakers		
Mailing Address: 424 Trapelo Road, Waltham, MA 02254		
Mr. Thomas C. Bruha	Planning	617-647-8554
Mr. Charles J. Wener	Engineering	617-647-8686
Dr. Franklin W. Fessenden	Planning	617-647-8564
Ms. Catherine O. LeBlanc	Planning	617-647-8737
Mr. Michael D. Misslin	Planning	617-647-8534
Mr. William T. Coleman	Engineering	617-647-8168
Mr. Robert L. Harrington	Engineering	617-647-8615
Mr. Joseph L. Ignazio	Planning	617-647-8508
Mr. Robert G. Hunt	Planning	617-647-8546
Mr. Anthony R. Riccio	Engineering	617-647-8169
Mr. Christopher J. Lindsay	Operations	617-647-8212
Mr. Steven W. Congdon	Operations	617-647-8211
Mr. Richard F. Quinn	Planning	617-647-8216
Mr. John J. Caffrey	Emergency Operations	617-647-8270
Mr. Lawrence A. Blake	Engineering	617-647-8504
Mailing Address: Cape Cod Canal Field Office, P. O. Box J, Buzzards Bay, MA 02532		
Mr. Frank A. Morris	Operations	617-759-4431
NED Support		
Mailing Address: 424 Trapelo Road, Waltham, MA 02254		
Miss Ann Wright	Administration Services	617-647-8488
Mr. James G. Doucakis	Planning	617-647-8559
Mr. Warren Nordman	Public Affairs	617-647-8778
Mr. Wallace St. John	Operations	617-647-8304
Miss Mary Ronan	Administrative Services	617-647-8775
Mrs. Catherine E. Ravens	Planning	617-647-8548
Mrs. Susan Mehegan	Operations	617-647-8338
Mr. Donald Martin	Planning	617-647-8519
Mrs. Susan Douglas	Public Affairs	617-647-8264
Mr. Richard DeSimone	Planning	617-647-8550
Mr. Thomas J. Rosato	Emergency Operations	617-647-8272
Mailing Address: Cape Cod Canal Field Office, P. O. Box J, Buzzards Bay, MA 02532		
Mr. Francis N. Ciccone	Operations	617-759-4431

Outside Guest Speakers	Telephone No.
Dr. David G. Aubrey Woods Hole Oceanographic Institute Woods Hole, MA 02543	617-548-1400
Dr. Redmond R. Clark Assistant Director Mass. Department of Environmental Management Bureau of Solid Waste Disposal 100 Cambridge St. Boston, MA 02202	617-727-3260
Mr. William Richardson Anderson-Nichols 150 Causeway St. Boston, MA 02114	617-742-3400 Extension 246
Dr. W. Frank Bohlen Marine Science Institute University of Connecticut at Avery Point Groton, CT 06340	203-446-1023 Extension 256
Dr. Duncan Fitzgerald Boston University Geology Department 725 Commonwealth Ave. Boston, MA 02215	617-353-2530
Dr. Kenneth Fink University of Maine Ira C. Darling Center Walpole, ME 04573	207-563-3146
Dr. B. R. Pearce University of Maine Civil Engineering Department 453 Aubert Hall Orono, ME 04469	207-563-3146
Dr. Peter Cornillon University of Rhode Island Ocean Engineering Department Lippitt Hall Kingston, RI 02881	